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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT No. DP/ BUR/ 80/ 015

FEASIBILITY STUDIES IN SUPPORT OF THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE

17241

GEOLOGICAL REPORT FOR THE FEASIBILITY STUDY FOR A 200 TPD CEMENT PLANT AT LASHIO, SHAN STATE, BURMA

PREPARED BY: POLYTECHNA, PRAGUE
KERAMOPROJEKT, TRENČÍN
GEOLOGICKÝ PRIESKUM, SPIŠSKÁ NOVÁ VES
CZECHOSLOVAKIA

JANUARY, 1998

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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G E O L O G I C A L   R E P O R T

PREPARED BY :

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CZECHOSLOVAKIA

JANUARY, 1988

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ABSTRACT

- Title of project:
  The Feasibility Study for a 200 TPD Cement Plant at LASHIO, SHAN state, Burma
- Project No.: DP/BUR/80/015
- Results: 1. Re-evaluation of quantity and quality of limestone and clay of the MEHAN deposit. On the basis of the re-evaluation the deposit contains following reserves (resources) of raw - materials:

Limestone:	19 095 030	tons of reserves
	40 683 541	tons of resources
Clay :	2 348 766	tons of reserves
	112 066	tons of resources

  2. It was proved that Portland cement can be produced on basis of two components - limestone and clay (a ratio limestone: clay:ash of 80:19:1can be applied)
- Estimated production of the mini-cement plant is 200 tons of clinker per day (60 000 tons per year)
- It is proposed to supply the mini-cement plant with raw materials from the MEHAN deposit (limestone, clay), NAMMA deposit (coal), HSI-PAW deposit (gypsum) and SE-ENG source of sand, too.

ACKNOWLEDGEMENTS

Herewith I would like to express my thankfulness to those who contributed to fulfil targets of the mission in particular those concerning judgement of raw materials for production of cement in a minicement plant at LASHIO, Shan State.

In the first place, my thankfulness belongs to Mr. Chit Wai, director of Water Supply Materials Production Units project and Mr. Mint Swe, project manager, for flexible and prompt provision of necessary data.

My thankfulness also belongs to Mr. Aung Min from Industrial Planning Department for providing of various geological informations.

I must not forget to thank to Mr. Zaw Pe, Mr. Win Myint and Mr. Aye Myint Zaw from Department of Geological Survey and Exploration, Rangoon, for organizing the field geological works.

1 BACKGROUND INFORMATION

1.1 Introduction

The present Geological Report is an individual part of the Feasibility Study for setting up a minicement plant in the vicinity of the LASHIO Township, SHAN State.

The Field mission took place in the framework of the POLYTECHNA project No. 2312/72635, UNIDO contract No. 87/86/SM, project No. DP/BUR/80/015. The contracted Consultant is KERAMOPROJEKT Trenčín. This Geological Report is prepared by GEOLOGICKÝ PRIESKUM (Geological Survey), National Enterprise, Spišská Nová Ves.

The Consultant´s Team by UNIDO consisted of the following experts:

- Mr. Anton Mikula	- Team Leader
- Mr. Pavol Strapec	- Power Plant Specialist
- Mr. Igor Kostelný	- Mechanical Engineer
- Mr. Ján Benčík	- Industrial Economist
- Mr. Jaroslav Navrátil	- Financial Analyst
- Mr. Stanislav Mikoláš	- Geologist

Burma has experienced a cement shortage in recent years while total production capacity is 700 000 ton per year approximately.

Cement shortage has been particularly marked in remote areas of the country, one of these being the nothern part of the Shan state.

It is therefore intended to set up a cement plant at LASHIO in order to improve industrial and economic activities of the area.

Establishment of the cement plant in this area is suppcrted by availability of the raw materials (limestone, clay, sand, coal, hematite) in the vicinity of the LASHIO Township.

During November and December 1984, Ceramic Industries Corporation formed a data collecting mission which visited the project area and carried out necessary findings for the implementation of a preliminary study on a mini-cement plant in LASHIO Township.

The mission prepared a report, where three possible site alternatives were identified.

The Team of Consultants of Unites Nations Industrial Development Organization made inspection of the sites of the minicement plant at Lashio in December 1987.

Judgement of the most suitable site for the cement plant taking account of the existing raw materials resources and of properties of the raw materials considering for production of Portland cement, and opinion on infrastructure, were objectives of the inspection.

Another objective of the geological aspect of the inspection, apart from judgement of properties of the raw materials, was to carry out complementary laboratory tests and verify the results of qualitative properties of raw materials as specified on local documents.

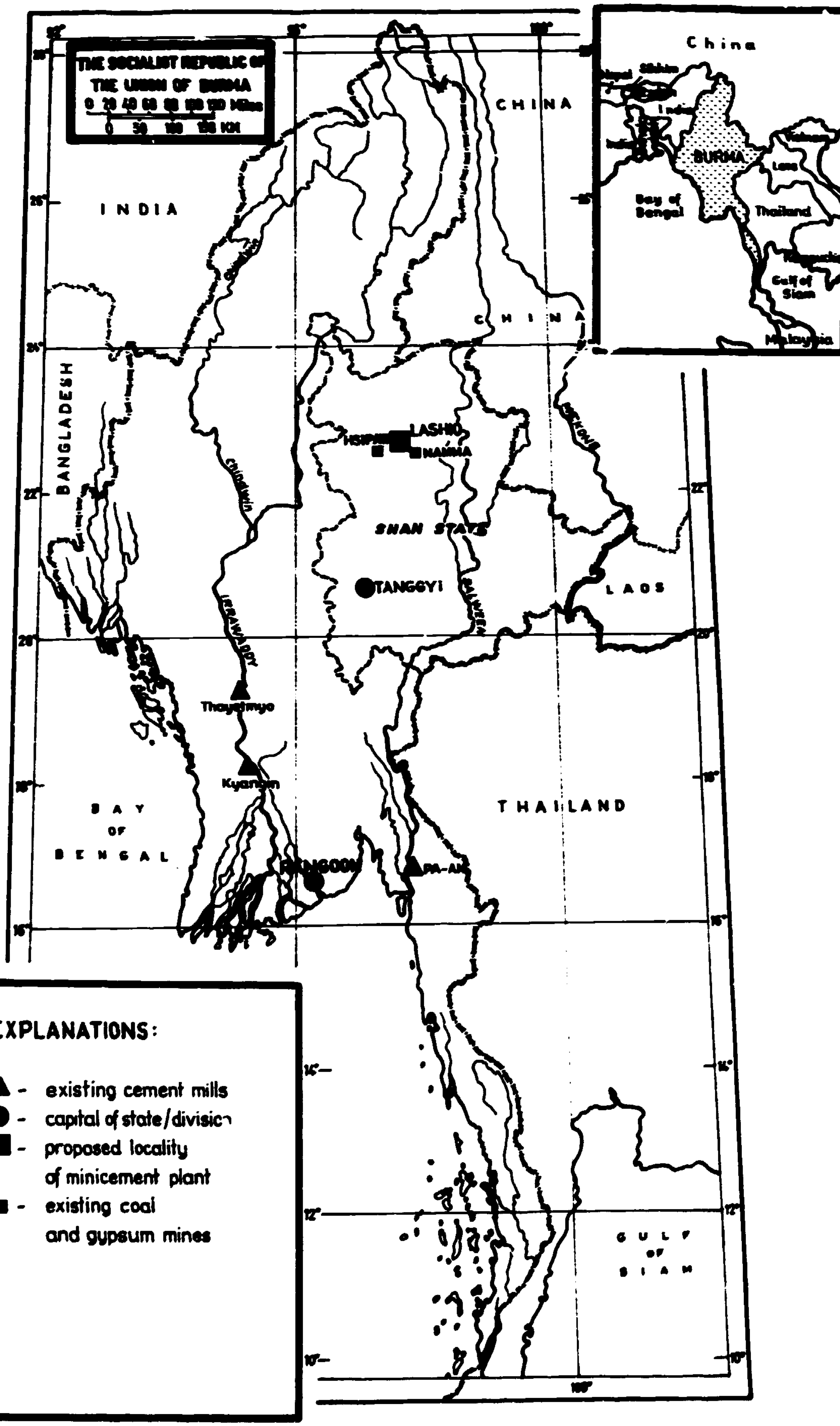

Figure – No.1: Burma's map

1.2 Geography

Prospected area broad environment is shown on the map sheets 93 F/9, 10, 13 and 14, scale 1 inch = 1 mile (1:63 360) as per Map No. 1 (belonging to NORTH HSENWI and HSIPAW Regions), altitude from 800 to 1 200 m above the sea level, making part of the Shan Plateau. It is situated on the southern slope of a mountaineous chain which comes from West to East.

The chain is built prevailingly by limestone and Permian and Devonian dolomites.

Morphology of landscape is formed by hills, even cliffs, altitude difference related to the surrounding landscape is from 100 to 150 m.

The area makes part of the IRRAWADDY river basin. It is drained by the NAM-PAWNGA and NAM-YAO creeks.

Road network is represented by the MANDALAY - LASHIO highway which is passable by vehicles all year round.

At LASHIO there is a single-track railway terminus connecting LASHIO with MANDALY and RANGOON.

Climate of the area is subtropical. Data on temperature of air from 1980 through 1987 are shown on the Table No.1.

Rainfall in LASHIO Township in years 1980 - 1987 is shown on the Table No. 2.

Evaporation and relative humidity in the year 1986 are shown on the Table No. 3.

Winds of the region blow prevailingly from NE and SE. Their speed in 1983-86 varied from 0 to 7,08 m/sec.

Abnormal meteorological conditions over the period from 1979 to 1987 are shown on the Table No. 4.

Year	Minimum		Maximum		Average (%)
	°C	Month	°C	Month	
1980	1,0	January	38,8	May	22,5
1981	2,0	January	34,0	April	21,8
1982	2,0	January-February	35,6	May	21,6
1983	0,3	January	35,8	April-May	21,3
1984	1,0	December	37,4	April	21,2
1985	-2,1	January	37,8	May	21,3
1986	1,0	January	37,4	April	21,8
1987	1,7	January-February	36,6	May	22,3

Table-No.1: Temperature data from 1980 to 1987
Source: Office of the Department of Morphology and Hydrology LASHIO

Month	1980	1981	1982	1983	1984	1985	1986	1987	Average (mm)
January	-	-	-	-	406,4	-	-	14,0	52,6
February	-	32,5	-	-	3,6	1,0	-	46,0	10,4
March	-	4,3	-	58,9	-	4,0	5,0	21,8	11,8
April	38,8	57,9	102,1	73,7	49,8	40,9	68,0	95,0	65,8
May	355,0	294,1	48,3	113,8	145,3	228,0	70,0	37,8	161,5
June	280,9	245,6	300,0	182,9	309,9	142,0	210,0	279,9	243,8
July	395,0	123,2	156,0	161,5	210,3	281,0	314,0	114,8	219,5
August	292,8	92,2	532,4	224,0	303,8	261,0	199,0	326,9	279,0
September	320,0	222,8	208,0	219,4	168,7	250,0	82,0	322,8	224,2
October	139,7	108,9	41,1	198,1	246,9	75,0	367,0	52,8	153,7
November	36,0	166,4	84,8	115,8	-	79,0	26,0	95,0	75,4
December	8,9	36,1	-	35,6	-	-	1,0	- *)	10,2

Table-No.2: Rainfall in LASHIO township in years 1980-1987 in mm
Source: Office of the Department of Meteorology and Hydrology LASHIO
Notice: *) Data not available

1.3 History of Geological Works

1.3.1 Works of Regional Nature

It is over 50 years since La Touche T.H.D. and Datta, P.N. of the Geological Survey of India, during the construction of the railway from Mandalay to Lashio, began the study of the geology of the Nothern Shan States. The result was a fine monograph (La Touche, T.H.D., 1913) which - although regarded by its author merely as a sketch the details of which, he hoped, would be filled in by others - remained the one and only comprehensive publication of this large and complex region of chiefly Paleozoic formations. His following articles dealing with broad area were published in the years 1900, 1907, 1908 and 1913. Datta, P.N. published his article in the year 1900.

The most recent paper (Brunnschweiler, R.O., 1970) is a summary of the results of studies in the geologicaly young Indoburman Ranges. It deals with some aspects of the geology of the more ancient Sinoburman Highlands which comprise Burma's eastern borderlands with China, Laos, Thailand and among them especially the Nothern Shan States and Karen State.

Further works referring to geological issues of the wider area are those by Aung Nyun (1955), Brown, J.C.(1938), Brunnschweiler, R.O. (1966), Buckman, S.S. (1917), Chhibber, H.L. - Ramamirthan, R. (1935), Fox, C.S. (1930), Healey, Maud, (1908), Middlemiss, C.S. (1900), Reed, F.R.G. (1903, 1920, 1936), Noetling, F. (1891).

The latest map summarizing all up to date information and data on geology of Burma, hence of the said territory is that from 1977, scale 1:1 000 000.

1.3.2 Works Directly Connected with the Deposits in LASHIO Area

It is proposed to supply the minicement plant with raw materials from the deposits of limestone (MEHAN, LUK-LE), clay (MEHAN), sand (SE-ENG, OLD LASHIO), hematite (NAM-HPAT), coal (NAMMA) and gypsum (HSI-PAW).

Extensive work has been carried out at limestone and coal deposits. As regards clay, sand and hematite all previous works were limited to collecting of samples and basic laboratory evaluation without any detailed geological evaluation. As regards gypsum, the HSI-PAW deposit being the most important gypsum deposit in Burma, it is sufficiently surveyed containing sufficient reserves.

Extensive geological works were carried out in MEHAN and LUK-LE in the period 1979 - 1983 (U Hla Aung, 1983). Prior to this, samples from broad areas south to the town of LASHIO have been searched for, collected and analysed.

More extensive works were made on spots where the chemical composition of the samples was suitable.

Taking into account considerably good properties of limestone from the MEHAN deposits and the selected site for erection of the proposed minicement plant, the said limestone has been selected as essential raw material. It is possible to use, however, raw materials from the LUK-LE deposit mainly as a correction raw material.

A total of 8 boreholes (DH-1 to 8) and 4 test pits were made within the period of searching. Detailed data on the borehole are shown in the Table No. 5. They were made by the diamond drilling method using water for rinsing. Core recovery was from 81 to 98 %, average of all being 90 %.

No borehole showed existence of underground water.

Samples were collected by 5 feet (1,525 m) distance

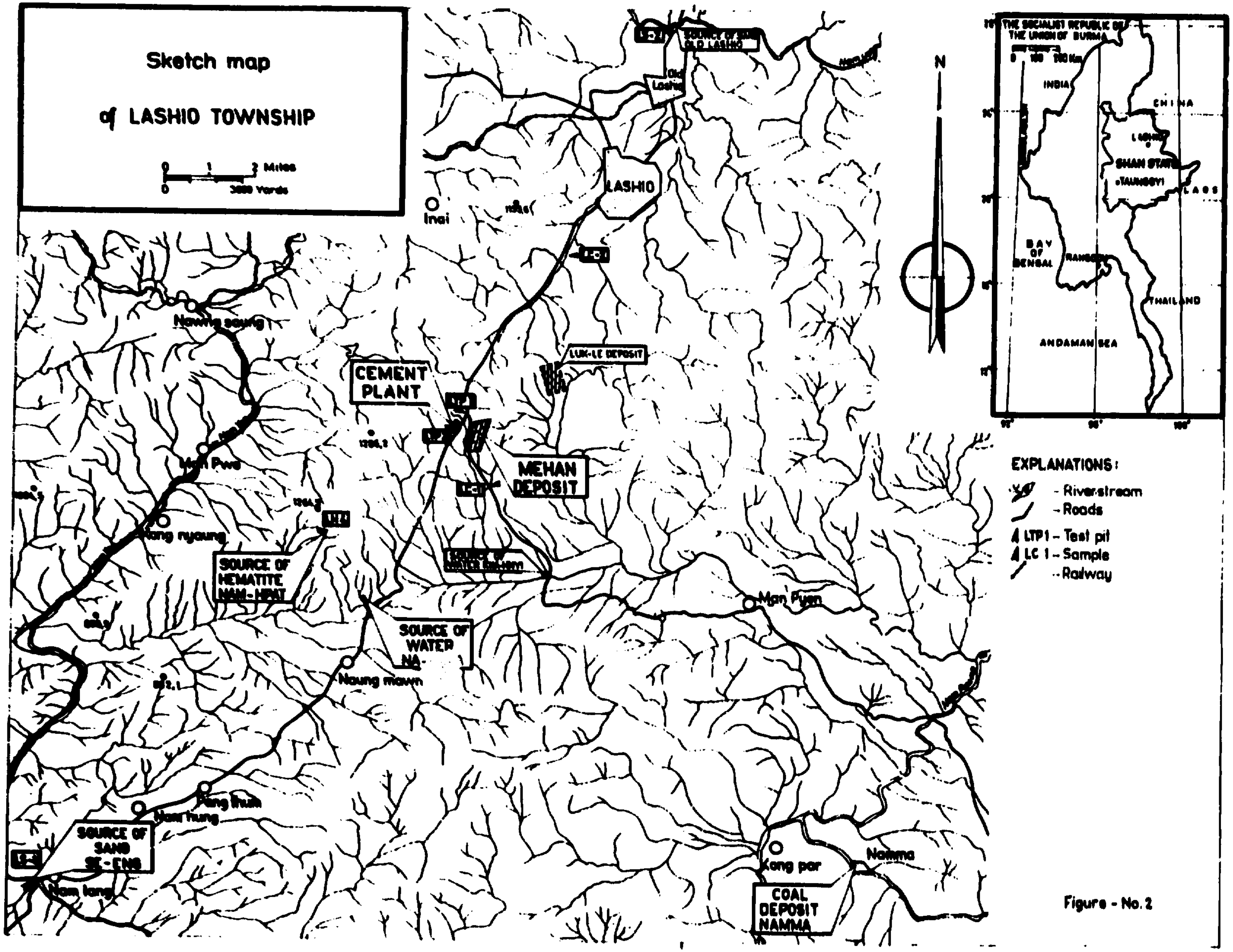
Sketch map
of LASHIO TOWNSHIP
0 1 2 Miles
0 3000 Yards
N
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA
INDIA
CHINA
SHAN STATE
LAOS
BAY OF BENGAL
THAILAND
ANDAMAN SEA
LASHIO
Old Lashio
SOURCE OF SAND OLD LASHIO
Inai
CEMENT PLANT
LUK-LE DEPOSIT
MEHAN DEPOSIT
SOURCE OF HEMATITE NAM-HPAT
SOURCE OF WATER NA
Nawng saung
Man Pwe
Nang nyaung
Naung mawn
Man Pyen
Pang thuh
Nam hung
SOURCE OF SAND SE-ENG
Nam lang
Kong par
Namma
COAL DEPOSIT NAMMA
EXPLANATIONS:
- Riverstream
- Roads
LTP1 - Test pit
LC 1 - Sample
- Railway

Figure - No. 2

each from the other and analysed in order to assess contents of SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, Na_2O, K_2O except for those referring to the borehole DH-1 which were analysed to assess contents of SiO_2 insolubles, R_2O_3, CaO and MgO. Contents of $CaCO_3$ and $MgCO_3$ were additionaly calculated. Qualities of raw material will be discussed in paragraph 2.2.1.

Location of the said boreholes and test pits is shown on the map No. 1. A pertinent map of coordinates and borehole coordinates were not available. The 1:2 000 map was set up by measuring.

A correct interpretation of the geological construction was handicaped due to the fact that the final report did not provide some important informations such as geological reports on boreholes, detailed description of other geological phenomena, etc.

The test pits (TP-1 to 4) were made in to determine thickness of overburden within depth of 30 feet (9,15 m). No test pit showed boundary between overburden and limestone.

Recovered material from the said test pits was examined in the laboratory. Results of the tests are presented in 2.2.2. hereinafter.

NAMMA coal deposit run by Ministry of Mines - Mining Corporation No. 3, is 36 km south-east to the site of the proposed minicement plant. Investigations at the deposit began in 1974 and coal production started in Fiscal Year 1975 - 1976.

A total of 23 boreholes have been made at the NAMMA deposit as yet. Specifications are shown on the Table No. No. 6.

The detailed description of geology and technological characteristics of coal is described in paragraph 2.2.6.

As regards other potential raw materials (sand, hematites),merely partial chemical analyses were available. No

Bore Hole No.	Depth of bore-hole in (ft)	Depth of bore-hole in (m)	Core Recovery in(%)	Started	Completed	Thickness of overburden in (ft)	Thickness of overburden in (m)
1	265'	80,8	82	5.05.80	5.06.80	6'	1,83
2	220'	67,1	91	27.08.80	3.09.80	2'	0,61
3	202'	61,6	93	17.09.80	24.09.80	5'	1,52
4	301'	91,7	88	21.11.80	1.12.80	14'	4,27
5	217'	66,2	98	13.11.80	21.10.80	3'6"	1,07
6	257' 6"	78,5	97	8.11.80	14.11.80	7'6"	2,28
7	170'	51,8	91	30.12.80	10.01.81	2'	0,61
8	170' 6"	52,0	81	11.12.80	23.12.80	29'	8,84

Table - No.5: Technical Data of Bore-Holes on MEHAN Limestone Deposit
Explanations: 1' = 30,5 cm; 1" = 2,54 cm;

Bore Hole No.	Level in m a.s.l.	Depth of bore-hole in (ft)	Depth of bore-hole in (m)	Core Recovery in (%)	Stratification of Coal Seam Strike	Stratification of Coal Seam Dip (To North)
1	564,9	257,5	78,53	68,	140°	52°
2	525,	230,5	70,30	83,72	135°	55°
3	525,	168,5	51,39	53,45	145°	55°
4	535,	145,0	44,22	40,19	160°	65°
5	544,	185,0	56,42	75,60	135°	58°
6	534,5	137,5	41,94	62,72	135°	75°
7	530,	308,0	93,94	63,40	135°	60°
8	528,	218,5	66,64	68,82	135°	60°
9	534,	172,0	52,46	74,09	140°	55°
10	519,	107,0	32,64	73,05	145°	57°
11	520,	235,0	71,68	68,1	140°	50°
12	520,	196,0	59,78	62,3	140°	50°
13	542,	455,5	138,93	71,5	140°	50°
14	541,	195,0	59,48	41,1	140°	50°
15	521,	286,0	87,23	53,9	140°	50°
16	525,	136,5	41,63	33,0	140°	50°
17	524,	300,0	91,5	31,27	100°	70°
18	513,	300,0	91,5	76,25	90°	90°
19	538,	500,0	152,5	71,5	90°	90°
20	531,	500,0	152,5	91,0	90°	90°
A	534,32	425,0	129,62	74,78	90°	90°
B	541,	500,0	152,5	61,4	90°	90°
C	544,5	500,0	152,5	60,1	90°	90°

Table - No.6: Technical Data of Bore-holes on NAMMA Coal Deposit data on clay being the essential raw material were available.

1.3.3 Misson Works in LASHIO Area

The objective of the geological aspect of the Field Mission was to verify acquired data and to complete them with activities, necessary for judgement of suitability of raw materials for production of Portland cement. Another objective was judgement of suitability of proposed sites for setting up the minicement plant.

In the first place it must be noted that the requirement to visit the Area three times, as per Terms of Reference, was not met due to security measures. The scope of field activities was reduced to one field trip in duration of two days.

During the field trip an inspection of the MEHAN limestone deposit was made and six (6) samples of limestone were collected. In close vicinity of TP-2 and TP-3 test pits, test trenches 1,5 m deep, were dug out, from which samples of clay (terra rossa) were taken for chemical analysis.

In order to provide adequate secondary raw materials, two more samples of clay and sand - clay coming from broad environment, more particulary North and South to the proposed site (NAMKHAL, KHA-SHI), were collected.

The Field Mission Programme prepared by the Burmese counterpart did not permit to visit resources of additional raw materials, in particular SE-ENG sand deposit and NAM--PHATE hematite deposit. Geologists from LASHIO arranged, however, availability of necessary samples from deposits in order to make available pertinent chemical analyses and screen tests.

The visit paid to NAMMA coal - mines was very instructive. During the visit it was possible to verify some information which were vague and acquired new information. On this occasion samples of coal were taken to carry out complete judgement of its properties.

For the sake of assessment of the soil conditions of the proposed minicement plant site, inspection of soil was made and two (2) 3 m deep test pits were dug out. Four (4) samples for soil tests and four (4) samples for chemical analysis were collected.

The samples were analysed at laboratories of the Central Research Organization, Ministry of No. 2 Industry - - RANGOON, and at Soil Testing Laboratory TAUWANNA, construction Corporation - Burma.

Check analyses were made at laboratories of Geologický Prieskum n.p. Spišská Nová Ves, Czechoslovakia.

2 GEOLOGY

2.1 Geology of the surrounding area

The oldest member constructing the whole area of the prospected territory is PRECAMBRIAN. PALEOZOIC rocks (Ordovician, Silurian, Devonian and Permian) prevail. MESOZOIC rocks (Triassic + Jurassic) and Kaenozoic (Miocene - Pliocene) are of younger origin.

Ordovician and Silurian are formed by carbonate sequences.

The misleading Traditional term Plateau Limestone (Brunnschweiler, R.O., 1970) (Devonian - Permian) is abandoned. The Devonian part is to be known as SHAN DOLOMITE - - with the Eifelian Padaukpin Limestone and the Givetian Wetwin shale as subordinate member formation - and disconformable Permian as TONBO LIMESTONE.

Carboniferous formations are absent.

Triassic and Jurassic are present, but the Cretaceous is absent. The BAWGYO GROUP (Upper Triassic and Rheatic) rests unconformably on the Palaeozoic and consists of the PANGNO EVAPORITES (below) and the NAPENG FORMATION. The Jurassic Namyau Group, consisting of the TATI LIMESTONE (Bathonian - Callovian) and the HSIPAW REDBEDS (Middle to Upper Jurassic) follows unconformably.

Shan Dolomite (essentially of mid - Devonian age) is thick bedded and in many places even massively coralline (Knols and Fenses).

The Permian (chiefly Artinskian), in the form of the Tonbo Limestone is characterised by the absence of reef facies.

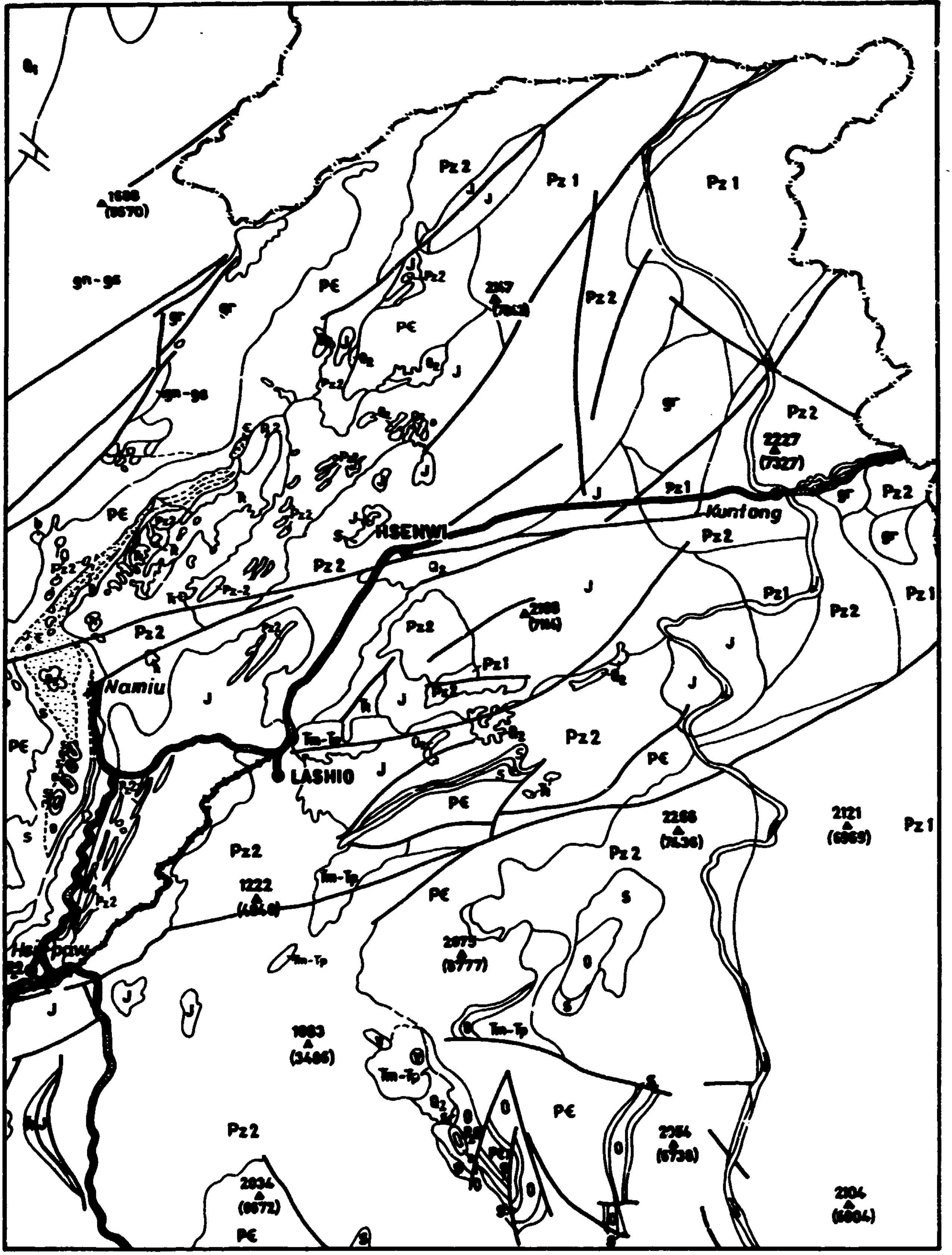

Figure - No.3: Geological map of Environment, scale - 1: 1,000,000, 1977

Explanations:

- Q_2 — HOLOCENE - Alluvium
- Q_1 — PLEISTOCENE - Older Alluvium and Gravels
- Tm-Tp — MIOCENE - PLIOCENE Irrawaddy Formation and its equivalents
- J — JURASSIC Namyau Series. Loi-an Series and their equivalents
- Tr — TRIASSIC Sawgyo Group. Kamawkala Limestone and their equival.
- Pz2 — UPPER PALEOZOIC - (mainly CARBONIFEROUS - PERMIAN) Plateau Limestone. Moulmein Limestone and their equivalents
- Pz1.2 — PALEOZOIC - (mainly UPPER PALEOZOIC - partly LOWER PALEOZOIC) Mergui Series. Mawchi Series and their equivalents
- S — SILURIAN
- O — ORDOVICIAN Pindaya Group (of Southern Shan States) and its equivalents
- Є — CAMBRIAN - Panguun Beds of Norther Shan States: Molohein Group of Southern Shan States
- Pz1 — LOWER PALEOZOIC - Undifferentiated rocks of probably - LP. age exposed in the eastern part of the Shan States and Kayah St.
- PЄ — PRECAMBRIAN Chaungmagyi Series and its equivalents
- gn-gs — UNDIFFERENTIATED METAMORPHICS (mainly SCHISTS and GNEISSES)
- gr — GRANITES and other NON - BASIC INTRUSIVES gr2 - MESOZOIC; gr1 - PALEOZOIC. Unnumbered where age is not known
- b — GABRO and related INTRUSIVES
- V — VOLCANICS - (mainly BASIC) (mainly CENOZOIC)
- a, - Faults - dashed where concealed or aproximately located

The intense primary folding of the Triassic and Jurassic sequences of Northern Shan States is due to gravity sliding (Gleittektonik) on the Upper Triassic evaporites. Secondary complications were introduced by diapiric displacements which are probably continuing. Neither of these tectonic phases shows at best responsible for minor everprinting, chiefly through broad warping and Horst - and - Graben fracturing of the Shan Dolomite with locally considerable vertical displacements. There are no alpine structures in the region. Geotectonically, it was a well-consolidated frontal block of the alpidic hinterland.

2.2 Geolog Properties and Reserves of Raw Materials

2.2.1 Limestone

Geology

The most suitable resources of carbonates, being the essential raw material for production of Portland cement, are those coming from the MEHAN deposit. These are part of the carbonate complexes known as plateau limestone of Devonian (Permian age). Recently, a tendency of not using the term Plateau Limestone has prevailed (Brunschweiler, R.O., 1970) since Carboniferous has not been found in this complex of strata. Devonian of the complex of strata is known as Shan Dolomite and Disconform Perm as Tonbo Limestone, respectively.

The exact stratigraphic classification of carbonates of the MEHAN deposit is not possible since no detailed geological investigation has been carried out as yet. A carbonate complex of strata is layered by limestone, sandy dolomitic limestone, dolomitic limestone and brecciated limestone.

The deposit of the Carbonate complex is layered mostly by limestone and brecciated limestone with CaO content mostly more than 53 % ($CaCO_3$ content more than 95 %). Dolomitic limestone is the bottom of the Carboniferous complex of strata, alternatively thin layers inside limestone strata.

Limestone is mostly of dark-grey colour with brown shade and is robustly compact, often laminated. Apart from calcite, accessories of hematite and limonite are present. The average size of calcite grain is 0,009 x 0,006 mm which is identical with microsparite. The shape of grains is alotriomorphic. A rare occurrence of flaser-type nests filled up with micritic and sparitic calcite can be seen. It was found that size of the nests was 0,19 to 0,15 mm. Thickness of grains in the nests achieves values of 0,03 mm. The shape of grain in the nests is hypidiomorphic and allotriomorphic.

Limestone is disturbed by calcite veins network. Thickness of veins can achieve order of cm. Limestone is of layer shape. Lamination observable on a fresh fracture is probably caused by emulseous pigment. 'Stylolites along which calcite veins are developped, can often be seen.

Bedding trends NE - SW to NW - SE, bed dip is 10 - 30 towards SE - NE. Fold structures were not identified. Change in bedding was probably caused by existence of fault tectonic which cannot, however, be interpreted due to lack of detailed information. The MEHAN limestone is not accompanied by any additional raw materials.

Overburden thickness is from 0 to 8,84 m. The overburden shall be processed during operation completely, and is formed by weathered limestone and terra rossa.

2.2.1.2 Technological Evaluation

Suitability of raw materials for production of Portland cement is subject to universal investigation of chemical and mineralogical compositions and to evaluation of physical-mechanical properties.

As to evaluation of quality this must be based on applicable requirements for raw-mix composition and on requirements of the proces selected. These are described in Chapter 3.

Originally, limestones both from MEHAN and LUK-LE deposits were intended to use for production of cement. After consideration of qualities of both limestones and infrastructural conditions, the MEHAN limestone only is proposed to use.

In order to carry out more detailed evaluation of the MEHAN limestone, a repeated investigation on quantity and quality of raw materials was made. Comparison of average chemical compositions of limestone coming from different sources is indicated in the Table No. 7.

One of the main objectives of the Field Mission was to verify reliability of evaluation methods. Chemical analyses of limestone samples collected during the Field Mission and comparison of the basic and check analyses are shown in the Table No. 8.

Since the method of aclinal section was adopted to determine quantity of limestone reserves, quality evaluation was carried out individualy for each bench. Quality of limestone per bench is shown in the Table No. 9. In order to verify properties of limestone, original chemical analyses resulting from geological survey during 1980 - 1982, were used. Chemical composition of limestone from individual benches was calculated by weighted average from working account of lengths of sampled sections. Mean chemical compositions of reserves and resources were determined by

Average quality	Chemical composition in %							
	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Na_2O	K_2O	L.O.I.
Average quality of bore - holes BH 1 - 8 Source 1.	2,2	0,33	0,77	51,89	1,74	0,006	0,043	
Average quality of samples MDH 1 - 8 Source 2.	1,25	0,30	0,61	54,25	0,75			42,67
Average quality of reserves (resources) of the Mehan dep Source 3.	1,790	0,118	0,710	53,322	0,86	0,009	0,048	
Average quality of samples LL - 7,8,10 Source 4.	0.497	0.15		52.996	0.56	0.07	0,23	43.18
Average quality of samples LL - 1,2,3,10 Source 5.	0,515	0,132	0,165	55,12	0,395	$<$0,02	0,02	43,45

Table -No.7 : Comparison of chemical composition of limestone of the MEHAN deposit.

Source 1 : Report of the data collecting mission for the implementation of preliminary study on Mini-cement Plant in LASHIO Township.

Source 2 : Chemical composition of limestone of the MEHAN deposit, tested by cement mill No.1.

Source 3 : Chemical composition of limestone of the MEHAN deposit, recalculated by mission works in 1987.

Source 4 : Analysis by Central Research Organization Ministry of No.2, Industry, RANGOON.

Source 5 : Analysis by Geological Survey, National Enterprise, Spišská Nová Ves.

Sample No.	Source	Chemical composition in %												
		SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	TiO_2	P_2O_5	Na_2O	K_2O	MnO	SO_3	Cl	L.O.I.
LL-1	B	0.93	0.26	0,13	54,69	0,39	0,014	Tr.	Tr.	0 03	0,003	0.09		43,26
LL-2	B	0,43	0,15	0,16	55,40	[illegible]	0,010	Tr.	Tr.	Tr.	0,005	0,04		43,48
LL-3	B	0,29	0,11	0,13	55,20	0,57	0,009	0,03	Tr.	Tr.	0,006	Tr.		43,64
LL-7	A	0,73		0,18	52,42	0,48			0,67	0,24				43,24
LL-8	A	0,50		0,13	53,64	0,48			0,67	0,21				43,11
LL-10	A	0,26		0.14	52,93	0,72			0,67	0,24				43,18
	B	0,41	0,14	0,11	55,20	0,36	0,009	0,02	Tr.	0,02	0,001	0.14		43,42
	Ꞁiff.	0,15		0,03	2,27	0,36				0,22				0,24
Average	A	0,497		0,15	52,99	0,56			0,67	0,23				43,17
	B	0,515	0,165	0,132	55,12	0,395	0,042		Tr.		0,004			43,45

Table - No. 8: Chemical composition of limestone of the MEHAN deposit

Explanations: A – Analysis by Central Research Organization Ministry of No.2 Industry, RANGOON; B – Check analysis (Analysis by Geological Survey, National Enterprise Spišská Nová Ves; Tr. – Traces < 0,02;

Block of reserves (resources) No.	Reserves (resources)	Bench in m a.s.l.	Chemical composition in %								
			SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Na_2O	K_2O	MS	MA
$1C_2$	reserves	1029	0,892	0,084	0,721	49,04	4,89	0,007	0,014	1,11	3,54
		1014	1,072	0,099	0,625	54,16	0,57	0,008	0,047	1,48	6,32
		999	1,233	0,108	0,518	53,22	1,60	0,008	0,038	1,97	4,80
		984	2,215	0,150	0,590	53,62	0,44	0,008	0,036	3,00	3,93
		969	1,849	0,112	0,860	52,80	1,11	0,009	0,061	1,90	7,68
		954	1,447	0,090	0,818	53,86	0,77	0,009	0,038	1,59	9,09
		939	2,039	0,137	0,614	53,00	1,04	0,009	0,054	2,72	4,48
2P	resources		1,55	0,11	0,70	53,27	0,97	0,009	0,046	1,91	6,36
3P			1,81	0,12	1,04	53,52	0,41	0,010	0,058	1,56	8,67
Average quality of reserves			1.790	0,118	0,710	53,32	0,86	0,009	0,048	2,16	6,02
Average quality of resources			1,62	0,11	0,8	53,34	0,81	0,009	0,049	1,78	7,27

Table - No. 9: Quality of limestone of the MEHAN deposit.

using weighted average referred to the quantity of resources (reserves).

Limestone contains very low concentrations of harmful admixtures. The only spot where content of MgO is beyond the limit of 3 %, is the bench 1 029 m a.s.l. The samples collected by the Consultant during the Mission contain 0,72 % at max. Some boreholes were observed in order to assess mutual dependence of individual oxides. There is a medium to strong dependence between CaO and MgO (correlation coefficient = 0,91 - 0,74). There is a weak dependence between contents of CaO and alkalis (C.C. = 0,37). Eventually, there is a medium dependence between contents Fe_2O_3 and alkalies (C.C. = 0,74).

There are traces of Na_2O content. Maximum measured content was below 0,01 %.

Content of K_2O is in order of several hundredths of %.

Maximum content of SO_3 is 0,14 % and content of Cl <0,01%.

Contents of trace elements are shown in the Table No. 10.

X-Ray and DTA analyses have not proved presence of any minerals except calcite.

The LL-7,8 and 10 samples of limestone were subject to physical and chemical tests in order to assess its properties from the processing point of view. On the basis of carried-out tests limestone indicates properties as shown in the Table No. 11.

The LL-10 sample was tested for grindability using the VTI method. Value of grindability is 1,286 (VTI), i.e. limestone is easily grindable.

On the basis of process-wise evaluation it can be stated the MEHAN limestone can be classified as the so called high percentage limestone suitable for producting any type of cement, including white cement of lime and for demanding industrial utilization.

Sample No.	Source of analysis	Spectrographic analysis						
		B	Cd	Cu	Pb	Zn	Sb	Sr
LL-1	B		Tr	4 ppm	Tr	9 ppm	Tr	
LL-2	B		Tr	4 ppm	Tr	5 ppm	Tr	
LL-3	B		Tr	4 ppm	Tr	4 ppm	Tr	
LL-7	A	T	Nd	W	Nd	Nd	Nd	Nd
LL-8	A	T	Nd	W	Nd	Nd	Nd	Nd
LL-10	A	T	Nd	W	Nd	Nd	Nd	Nd
	B		Tr	4 ppm	Tr	11 ppm	Tr	

Table - No.10 : Results of spectrographic analysis

Explanations : FT = < 0,001 % ; T = 0,001 - 0,01 %; W = 0,01 - 0,1 % ;

Nd = Not detected ; Tr=Traces /<0,001/

A - Analysis by Central Research Organization, Ministry of No.2 Industry, RANGOON;

B - Analysis by Geological Survey, National Enterprise Spišská Nová Ves

Specifications		Sample No.			
		LL-7	LL-8	LL-10	
specific gravity	(kg/m³)	2 682	2 693	2 700	
specific density	(kg/m³)	2 707	2 708	2 711	
soaking	(%)	0,3	0,2	0,1	
soaking (calculated)	(%)	0,8	0,5	0,3	
void ratio	(%)	0,9	0,55	0,4	
relative density	(%)	99,1	99,45	99,6	
crushing strenght	(MPa)	34			
grindability	(VTI)			1,286	

Table - No.11 : Physical tests of the limestone of the MEHAN deposit.

2.2.1.3 Reserves

Estimated demand of limestone for production of Portland cement is 260 tons per day (78 000 tons per year).

Quantity of reserves of the MEHAN deposit accoonting to the drilling studies by Department of Geological Survey and Mineral Exploration are as follows:

24 millions ton - P

23,22 millions ton - P_2

As stated in paragraph 2.2.1.2, verification of quality and a new calculation of MEHAN reserves using data from the Report on Geological Survey 1980-1982, were carried out. The main reason for verification is the fact the original calculation did not take into consideration clay as another component of raw-mix. Neither quality nor quantity were evaluated and calculated.

The method of geological blocks was employed for the new calculation of reserves. The method of aclinal (bench) sections was employed for calculation of volume in the blocks. Reserves and resources of limestone and clay were calculated due to the inequal rate of survey per individual parts of the deposit.

The basis for calculation of the rererves was set at 939 m a.s.l. Boundaries of the block of reserves is drawn to positive workings.
Thickness of clay was calculated on the basis of the geological interpretation and geological sections.

The prognostic resources are projected vertically below the block as low as 915 m a.s.l. and horizontally as far as limestone boundary. In the north, the block of prognostic resources is terminated at the DH-1 borehole.

Surface of blocks was determined by means of polar planimeter from a map, scale 1:2 000.

Weight of reserves determined by using the volumetric weights of limestone and clay which in turn were assessed from the collected samples.

LIMESTONE – Reserves

Block No.	Bench in m a.s.l.	Limestone in m³	Spec. gravity g/cm⁻³	Limestone in t	Chemical composition in %									
					SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Na_2O	K_2O	M_S	M_A	S_{LP}
$1C_2$	1029	16 727	2,69	44 996	0,892	0,084	0,721	49,040	4,886	0,007	0,014	1,11	8,54	1441,1
	1014	154 305	2,69	415 080	1,072	0,099	0,625	54,156	0,573	0,008	0,047	1,48	6,32	1423,9
	999	472 145	2,69	1 270 070	1,233	0,108	0,518	53,216	1,601	0,008	0,038	1,97	4,80	1287,3
	984	951 537	2,69	2 559 635	2,215	0,150	0,590	53,618	0,444	0,008	0,036	3,00	3,93	766,4
	969	1465 990	2,69	3 943 513	1,849	0,112	0,860	52,801	1,106	0,009	0,061	1,47	2,18	844,4
	954	1874 769	2,69	5 043 129	1,447	0,090	0,818	53,861	0,771	0,009	0,038	1,59	9,09	1061,2
	939	2 163 051	2,69	5 818 607	2,039	0,137	0,614	53,004	1,043	0,009	0,054	2,72	4,48	812,6
Total		7 098 524	2,69	19 095 030	1,790	0,118	0,710	53,322	0,86	0,009	0,048	2,16	6,02	899,7

– Resources

Block No.	Bench in m a.s.l.	Limestone in m³	Spec. gravity g/cm⁻³	Limestone in t	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Na_2O	K_2O	M_S	M_A	S_{LP}
2P		10 861 993	2,69	29 218 761	1,55	0,11	0,7	53,27	0,97	0,009	0,046	1,91	6,36	1017,1
3P		4 262 000	2,69	11 464 780	1,81	0,12	1,04	53,52	0,41	0,010	0,058	1,56	8,67	839,8
Total		15 123 993		40 683 541	1,62	0,11	0,8	53,34	0,81	0,0[illegible]	0,049	1,78	7,27	960,8

Table – No. 12 : Reserves (resources) of limestone of the MEHAN deposit

Results of calculations of the reserves and resources of limestone are shown in the Table No. 12.

2.2.2 Clay

2.2.2.1 Geology

Clay is another raw material to be found at the MEHAN deposit. It fills the depressions between the limestone crests and the flat parts of the landscape,it makes continuous surface of the landscape.

It is the product of weathering of rocky complexes layering the SHAN PLATEAU.

From the petrographical point of view, clay can be characterized as red-brown or dark brown terra rossa with variable chemical composition. Following minerals were detected: quartz, illite, kaolinite, goethite, calcite, dolomite and feldspar.

On basis of granulometric analysis, it was found that clay consists of 10-18 % of sand grains, size of 0,063 to 2 mm, 68 - 57 % of dust particles, size of 0,001 to 0,063 mm and approx. 22 - 25 % of clay particles, size of below 0,002 mm.

2.2.2.2 Technological Evaluation

Clay is the second raw material component necessary for production of Portland cement, found at the MEHAN deposit.

Requirements on properties, likely to limestone, result from requirements on raw-mix properties, as per Chapter 3.

Since only one chemical analysis of clay was available during Consultant´s field activities it was deemed necessary to verify properties of clay coming from the said deposit as well as from broad environment.

During field works, trenches 1,5 m, were dug out in the close vicinity of TP-2 and TP-3 test pits and samples identified as LL-5 and LL-6 were collected for chemical analys s. Samples from test pits, identified as LTP-1 and LTP-2, dug out for soil tests, were also collected for chemical analysis. Samples are identified as LM-1 and LM-2. Other two samples were collected in the vicinity of NAMKHAL village (LC-1) and KHA-SHI village (LC-2).

Results of chemical analyses and comparison of the basic and check ones are shown in the Table No. 13.

Sample No.	Source of anal.	Chemical composition in %												
		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	MnO	P_2O_5	Na_2O	K_2O	SO_3	Cl	L.O.I.
LL - 5	A	43,68	14,16	8,51		n.d.	1,38							31,98
	B	56,50	20,63	8,83	1,172	0,07	0,53	0,156	0,20	0,07	1,24	Tr.	Tr.	10,08
	Diff.	12,82	6,47	0,32			0,85							
LL - 6	A	53,55	15,05	7,46		n.d.	1,26							22,34
	B	50,58	23,30	10,59	1,221	0,17	0,61	0,143	0,23	0,04	1,12	0,03	Tr.	11,32
	Diff.	2,97	8,25	3,13			0,65							
LM - 1	A	52,77	6,68	5,25		n.d.	0,85							34,01
LM - 2	A	59,56	11,58	4,83		n.d.	0,72							22,95
	B	74,75	12,13	5,35	0,730	0,03	0,40	0,092	0,04	0,02	0,92	Tr	Tr.	4,94
	Diff.	15,19	0,55	0,52			0,32							
LM - 3	A	30,87	20,30	11,27		n.d.	0,42							36,42
LM - 4	A	30,91	20,79	9,38		n.d.	0,70							38,09
	B	43,68	27,65	12,05	1,460	0,05	0,56	0,122	0,17	0,02	1,31	Tr.	Tr.	12,32
	Diff.	12,77	6,86	2,67			0,14							
LC - 1	A	83,89	5,58	3,12		n.d.	1,02							6,24
LC - 2	A	56,42	12,59	8,16		n.d.	1,18							20,29

Table - No. 13: Chemical composition of clay of the MEHAN deposit and LASHIO Township

Explanations: A - Analysis by Central Research Organization, Ministry of No.2 Industry, RANGOON; B - Analysis by Geological Survey National Enterprise, Spišská Nová Ves; Tr. - Traces; n.d. - not detected. Tr. = < 0,01%;

On the basis of the carried out chemical analyses, it can be stated that the chemical composition considerably varies both vertically and horizontally and a significant difference of results of both laboratories can be noted. For this reason, hereinafter results by GEOLOGICKÝ PRIESKUM will be used for calculations.

For comparison, average chemical composition of MEHAN clay, received from Ministry of No. 1, Industry, Ceramic Industries with average chemical composition calculated on the basis of new analyses, are shown on the Table No.14.

Chemical analysis of the LL-5 sample is used for calculation of raw-mix (Chapter 3).

Concentration of harmful matters (Na_2O, K_2O, TiO_2, MgO, MnO, P_2O_5, SO_3 and Cl) is shown in the Table No. 13. Concentration of other harmful matters is shown in the Table No. 15.

Physical properties of clay are shown in the Table No. 16.

Granulometric composition is discussed in paragraph 2.2.2.1.

2.2.2.3 Reserves

Estimation of clay demand necessary for production of Portland cement is 74 tons per day (22 000 tons per year).

Reserves and resources of MEHAN clay was calculated together with reserves and resources of limestone. Method of calculation is discussed in paragraph 2.2.1.3. Quantity of reserves and their quality is shown in the Table No. 17.

Average composition Source	Chemical composition in %					
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	L.O.I.
Average composition of the TP-2,4 Source A	63,0	18,35	8,49	1,90	0,72	6,49
Average composition of samples LL-5,6 Source B	48,615	14,6	7,985	N.D.	1,32	27,16
Average composition of samples LL-5,6 Source C	53,54	21,965	9,71	0,12	0,57	10,7

Table - No. 14 : Average composition of clay of the MEHAN deposit.

Source A: Ceramic Industries Corporation

Source B: Analysis by Central Research Organization Ministry of No.2 Industry, RANGOON.

Source C: Analysis by Geological Survey, National Enterprise Spišská Nová Ves

Sample No.	Source of analysis	Spectrographic analysis						
		B	Cd	Cu	Pb	Zn	Sb	Sr
LL - 5	A	T	ND	W	ND	ND	ND	ND
	B		Tr.	27 ppm	45 ppm	59 ppm	0,001 %	
LL - 6	A	T	ND	W	W	ND	ND	ND
	B		Tr.	29 ppm	48 ppm	122 ppm	0,001 %	
LM - 1	A	T	ND	W	W	ND	ND	ND
LM - 2	A	T	ND	W	T	ND	ND	ND
	B		Tr.	20 ppm	14 ppm	33 ppm	Tr.	
LM - 3	A	T	ND	W	ND	M	ND	ND
LM - 4	A	T	ND	W	W	ND	ND	ND
	B		Tr.	38 ppm	35 ppm	58 ppm	0,001 %	
LC - 1	A	T	ND	W	ND	ND	ND	ND
LC - 2	A	T	ND	W	W	ND	ND	ND

Table - No. 15 : Spectrographic analysis of clay.

Explanations: A - Analysis by Central Research Organization Ministry of No.2 Industry, RANGOON; B - Analysis by Geological Survey, National Enterprise, Spišská Nová Ves; T - 0,001-0,01 %; W - 0,01 - 0,1 %; ND - not detected; M - 0,1 - 1,0 %; Tr - Traces (0,001%)

Sample No.	Source of anal.	Specifications			
		specific gravity g/cm^{-3}	tippet density /compact/ g/cm^{-3}	tippet density g/cm^{3}	Moisture cont. %
LL – 5	A	2,66			31,0
	B				29,8
LL – 6	A				
	B	2,69	1,200	0,816	30,3
LM – 1	A	2,65			25,8
	B				
LM – 2	A	2,65			24,6
	B				28,2
LM – 3	A	2,66			43,0
	B				
LM – 4	A	2,66			43,0
	B				39,2
LC – 1	A				
	B				16,4
LC – 2	A				
	B				26,0

Table - No. 16: Physical tests of clay

Explanations: A – Analysis by Soil testing Laboratory TAUWANNA, Construction Corporation; B – Analysis by Geological Survey, National Enterprise Spišská Nová Ves.

CLAY — Reserves

Block No.	Bench in m a.s.l.	Clay in m^3	Spec. gravity g/cm^{-3}	Clay in t	Chemical composition in %									
					SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Na_2O	K_2O	M_S	M_A	S_{LP}
$4C_2$		443 296	2,0	886 592	56,50	8,83	20,63	0,07	0,53	0,07	1,24	1,92	2,34	0,04
$5C_2$		716 087	2,0	1432 174	50,58	10,59	23,30	0,17	0,61	0,04	1,12	1,49	2,20	0,10
Total		1 159 383		2 348 766	52,84	9,92	22,28	0,13	0,58	0,05	1,17	1,64	2,25	0,07
— Resources														
6P		56 033	[illegible],0	112 066	52,84	9,92	22,28	0,13	0,58	0,05	1,17	1,64	2,25	0,07

Table-No. 17: Reserves (resources) of clay of the MEHAN deposit.

2.2.3 Coal

2.2.3.1 Geology

NAMMA coal deposit under Mining Corporation No. 3 is 4 furlongs away from NARNANT village (village group of NANT PAUNG), 35 miles in the SOUTH - EAST of LASHIO township. Grid location - 93 F/14 ST 807286.

The deposit is part of tertiary sedimentary basin formed along the fault line, general direction NEE - SWW in the carbonates of paleozoic (Devon, Perm).

Stratification of the tertiary sedimentary rocks is oriented 200 - 230^{o}, dip 30 to 45^{o} towards SW. Tertiary complex of strata was examined to the depth of 500 feet maximum (150 m). Transversal fault of general direction of NW - SE being the part of step-type fault formation was verified by the boreholes No. C 9 between A and B boreholes. In the vicinity of faults the dip of strata of sedimentary rocks is equal to 23 - 30^{o}. The idealized succession of strata as per boreholes is the following:

a) Clay
b) Coal
c) Clay and sandy clay
d) Coal
e) Clay and sandy beds
f) Coal
g) Sandy beds
h) Coal
i) Sandy clay and sandstone

Thickness of coal seam varies from 5 to 50 feet (1,5 - 15,2 m). The deposit is layered by three seams:

Upper coal seam	-	thickness	5′ - 10′ (1,5 - 3,5 m)
Middle coal seam	-		5′ - 15′ (1,5 - 4,6 m)
Lower coal seam	-		20′ - 50′ (6,1 -15,2 m)

In the top of the lower coal seam fire clay was discovered, thickness of 3 m, along the whole deposit. This has not found utilization as yet.

2.2.3.2 Technological Evaluation

Properties of mined coal from the deposit is shown in the Table No. 18.

Particulars	Results of analysis					
	level 470 - 525 M.A.S.C.	level 410 - 470 M.A.S.C.	upper seam	middle seam		lower seam
			LU-1	LU-2	LU-4	LU-3
W_t^r [%]	15,28	8,64	22,62	26,73	25,09	23,64
A^r [%]	9,95	13,04	5,99	5,94	5,56	3,56
A^d [%]	11,60	20,69	7,74	8,11	7,42	4,66
Q_i^r $[MJ.kg^{-1}]$	18,09	21,20	19,40	18,33	17,71	18,86
Q_i^r [Btu]	7771,29	9107,31	8333,16	7872,30	7608,04	8103,60
Q_i^d $[MJ.kg^{-1}]$	21,79	23,42	25,79	25,91	24,47	25,46
Q_i^d [Btu]	9360,0	10061,0	11079,13	11130,68	10512,07	10937,37
V^{daf} [%]	59,32	55,87	48,91	42,68	46,39	40,34
VN^{daf} [%]	40,68	44,13	51,09	57,32	53,61	59,66
S^d [%]	1,2	1,44	1,26	0,71	1,15	
As^d $[g.t^{-1}]$					10 ppm	
da^r $[g.cm^{-3}]$	1,3	1,3			1,33	

Table - No. 18 : Coal Specifications

In order to obtain more detailed data on properties of coal to be used as fuel on a proposed minicement plant at LASHIO, four (4) samples of coal were collected (LU-1, LU-2, LU-3 and LU-4).

The first three samples were analysed at the Central Research Organization, Ministry of No. 2 Industry, Rangoon and the fourth sample was analysed in laboratories of GEOLOGICKÝ PRIESKUM, národný podnik, Spišská Nová Ves, Czechoslovakia.

The average properties from the four collected samples including the Coal Mine Owner´s data are, as follows:

	Average	Min.	Max.
Original water content - W^r (%)	20,33	8,64	26,73
Original ash content - A^r (%)	7,34	3,56	13,04
Ash content - dry basis - A^d (%)	10,04	4,66	20,69
Wet test calorific value Q_i^r(MJ.kg^{-1})	18,93	17,71	21,20
Dry basis calorific value - Q_i^d "	24,47	21,79	25,91
Inflammable volatile - V^{daf} (%)	48,92	40,34	59,32
Fixed carbon - VN^{daf} (%)	51,08	59,66	40,68
Sulphur (dry basis) - S^d(%)	1,05	0,55	1,44
Arsenic (dry basis) - As^d(g.t^{-1})	10	10	10
Specific gravity - d_a^r(g.cm^{-3})	1,31	1,30	1,33

Original Water Content

This depends on the degree of coalification, genetic type, hydrological conditions, static pressure developed by overburden. It is also influenced by content and character of mineral water. Water content is a ballast deteriorating calorific value of coal. Data on water content provided by the Owner vary strongly.

Ash and Mineral Matters

Ash is another ballast component and its content reduces content of combustibles thus decreasing calorific value. Data on ash content provided by the Owner show higher concentration than those obtained by analyses of samples collected during the Field Mission.

Chemical Composition of Ash

Particulars	LU-1	LU-2	LU-3	LU-4
SiO_2 (%)	6,98	6,78	10,73	9,01
Al_2O_3 (%)	6,46	6,78	5,36	8,76
Fe_2O_3 (%)	12,27	11,71	15,45	8,54
CaO (%)	25,84	24,78	33,48	44,38
MgO (%)	22,22	24,07	11,80	5,53
TiO_2 (%)				0,39
MnO (%)				0,07
K_2O (%)				0,14
Na_2O (%)				0,02
P_2O_5 (%)				0,04
SO_3 (%)				17,79
Loss on ignition				0,50
H_2O				0,32

Silicate data of LU-4 sample (Fe_2O_3, CaO, MgO) essentially differ from those referring to LU-1,2,3 samples.

Acid/Basic oxides ratio = 0,30

SiO_2/Al_2O_3 ratio = 1,07

Temperature points:

t_A - softening point 1230°C

t_B - melting point 1300°C

t_C - creeping point 1350°C

The obtained data show medium meltability of ash. Ash is product of burning of mineral matter. Based on contents, as stated below:

Carbon dioxide (dry basis) 0,81 %

Ferrous oxide (dry basis)	0,30 %
Pyritic sulphur (dry basis)	0,62 %
Sulphatic sulphur (dry basis)	0,53 %
Organic and sulphide sulphur (dry basis)	1,15 %

A content of mineral matter without hydrate water M^d as well as hydrate water of mineral matter W_M^d regarding content of ash in dry residue - A^d = 7,42 %, was caculated.

$$M^d = 1,162 \cdot A^d = 8,624$$

$$W_M^d = 0,08207\ A^s = 0,609$$

Energy value is the essential quantity when evaluating any fuel. There is high calorific value, Q_s^{daf} which is assessed in laboratory conditions and lower calorific value which is the same reduced by latent heat of water present during burning. It is the calorific value in original state - Qi^r, i.e. including original water W_t^r respectively Qi^d - calorific value of dry sample (dry basis). This value is well comparable since it eliminates occasional errors in water content assessment.

The average value Qi^d referring to all 6 samples shown in the Table A is identical with that referring to the sample LU-4.

Combustible and its composition

Taking account of content of mineral watter M and of mineral matter hydrate watter $W_M{}^d$, Combustible of the examined coal has following composition (natural state):

Carbon	69,46 %
Hydrogene	4,45 %
Organic sulphur	1,21 %
Nitrogene	1,79 %
Oxygene	23,08 %

Total	99,99 %
Index of Coalification	37,58

Value of specific density is positively identical with that provided by the Owner.

$d_a^r = 1,33\ q.cm^{-3}$

Average content of sulphur assessed in our laboratories eguals to 1,15 %. It is supposed that about 44 % of sulphur will come into ash. The remaining part will fly into atmosphere. Arsenic concentrations were not found.

Semiquantitative spectral analysis showed existence of the following elements:

Ranging from 1 to 0,1 %	Sr
Ranging from to 0,01 %	Mn, Ba, Cu
Ranging from 0,01 to 0,001 %	Mo, B, Ag, Cr, Ni, Co, Sr, Y, Yb, V, Ga, Zn, Su

Other concentrations are not of interest.

2.2.3.3 Reserves

Estimation of coal demand necessary for production of Portland cement is 43 tons per day (12 900 tons per year).

According to the drilling tests done by the Mining Corporation No. 3 up to October, 1982, the deposit has 2,8 million tons of Coal reserves.

The upper portion, out of ground level was extracted since December, 1974. Up to the year 1983-84, 59 821 tons of coal was produced.

The capacity of the plant is 40 000 tons per year. The average production during 1984-1986 was 25 000 tons per year.

2.2.4 Sand

2.2.4.1 Geology

Sand of the LASHIO Township is an alluvial wash of the NAM-YAO (SE-ENG sand reserves, LS-1 sample) and of the NAM--PAWNG (north of OLD LASHIO resource, LS-2 sample) creeks, flowing into the River of IRRAWADDY.

Mineralogical analysis showed concentration of following minerals: quartz, mica, kaolinite and calcite.

On the basis of granulometric findings, the following can be stated: LS-1 contains 2 % of clay particles (below 0,002 mm), approx. 11 % of dust particles (below 0,063 mm), remaining 87 % of sand particles consist 50 % of fine sand fractions (0,063 - 0,250 mm) and 37 % of medium size sand (0,250 - 0,500 mm).

Chemical composition of sand is shown in paragraph 2.2.4.2. Detailed geological description is not made due to unavailability of pertinent information.

Sample	Source of analysis	Chemical composition in %											
		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	MnO	P_2O_5	Na_2O	K_2O	SO_3	L.O.I.
LS - 1 SE-ENG	B	81,44	6,47	2,89	0,353	1,48	0,61	0,03	0,02	0,12	2,10	0,06	3,42
SE-ENG	A	89,46	5,95	6,37		2,60	0,65						1,89

Table -No. 19: Chemical composition of sand of the SE-ENG deposit.
Explanations: A - Source of analysis - Ministry of No.1 Industry, C.I.C.
B - Analysis by Geological Survey, National Enterprise Spišská Nová Ves

2.2.4.2 Technological Evaluation

It is recommended to use the SE-ENG resource of sand due to suitable chemical composition and granulometric structure. They are shown on the Table No. 19.

The SE-ENG sand contains the following harmful matter: 8 ppm Cu, 22 ppm Pb. 106 ppm Zn and traces of Cd And Sb.

Moisture Content is 0,66 %

2.2.4.3 Resources

Estimation of sand demand necessary for production of Portland cement is 3 tons per day (900 tons per year).

No information on resources of sand was obtained and no locality was visited during the Field Mission.

2.2.5 Gypsum

2.2.5.1 Geology

Gypsum can be obtained from MAHNHE Mine under Mining Corporation No.3, 49 miles away in the south direction of LASHIO.

Near HSIPAW, over a distance of almost 16 km, along the Namtu valley, the contact zone between Paleozoic and Mesozoic is characterised by small exposures of strongly tectonised evaporites which frequently contain torn and fragmented beds of red shales and calcareous yellowish mudstones (Brunnschweiler, R. O., 1970). The evaporite masses consist of anhydrite, gypsum, halite, bittersalt (epsomite) and also traces of bromides. The ancient Bawngyo salt well (Ndetung, F., 1891), La Touche, T.H.D. (1907), Meyer, R. O. (1955) draws its mineralised water from this formation, maintaining an annual production by primitive evaporation of 500 - 600 tons of rather impure household salt (bitter salt contamination).

Judging from bore records (Aung Nyun, 1955) the Pangno evaporites rest on a very uneven, probably Karst-scarred surface of the SHAN Dolomite.

The Pangho evaporites are overlain, probably conformably (Napeng Type Shales occur between the contorted and torn fragments embedded in the evaporites) by the Rhaetic Napeng formation (Namyau Group), but in many places this has been removed by erosion before the onset of the Jurassic sedimentation, so that the red shales and sandstones of the Namyau Group are also found in direct contact with the Pangno rocks.

The largest outcrop of Pangno evaporites is located in a northfacing scarp about 3 km south of the Tati Ferry, west of the HSIPAW road and near the village of Pangno. From here comes the slightly salty gypsum which is used as an ingredient in the Nothern SHAN variety of soya bean cakes. Flow textured gypsum and anhydrite with traces of halite are exposed in the scarp of the type locality.

2.2.5.2 Technological Evaluation

The expected rate of gypsum consumption for Portland cement production would amount to 5-7 %. The essential criterion for evaluation of gypsum is content of $CaSO_4\ 2H_2O$ (min. 60 %).

Permissible content of anhydrite should be below 25 %. Content of admixtures deteriorating properties of finished cement such as Cu, Pb, Zr, Sr is not acceptable.

Even though there are more gypsum mines to supply the proposed LASHIO cement plant (PAKOKRU, LIN-GYI near AENANGAUNG), it is gypsum from HSIPAW (49 miles from LASHIO) that should be used. This gypsum is currently supplied to KYANGIN and THAYETMYO cement plants.

Chemical composition of gypsum is shown in the Tables No. 20 and 21 (By Feasibility Study Rehabilitation and

Year	Sample	Chemical composition in %						
		$CaSO_4 \times 2H_2O$	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	L.O.I.
1980	Tracks 6	85,71	6,32	–	1,01	0,6	30,3	19,39
1981	Storage 23	85,60	11,57	2,05	0,80	–	30,7	14,25
1982	Storage 9	84,68	11,81	2,22	0,93	–	32,4	11,90
Average		85,33	9,90	2,14	0,87	–	31,13	15,31

Table - No.20: Chemical composition of Gypsum
Source: Feasibility Study Rehabilitation and Extension
THAYETMYO Cement Factory

Laboratory	Chemical composition in %												
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	P_2O_5	MnO	SO_3	Cl	L.O.I.
A	2,01	–	0,25	0,11	0,43	30,6	–	–	–	–	44,9	–	21,26
B	1,25	0,10	0,46	0,27	0,56	31,24	0,08	0,09	0,03	0,0	43,89	27 ppm	21,90
C (LA-1)	5,72	0,0[illegible]	[illegible].62	0,74	2,37	30,59	Tr.	0,52	0,01	0,0	35,57		7,23

Table - No. 21: Chemical composition of Gypsum
Source: A – THAYETMYO Laboratory
B – Dickerhoff Engineering
C – Geological Survey, National Enterprise, Spišská Nová Ves.

Amount of reserves (mil. ton)	Production	
	Fiscal year	Production (ton)
12,3	1980 - 81	15 904
	1981 - 82	13 290
	1982 - 83	16 976
	1983 - 84	17 754
	1984 - 85	23 407
	1985 - 86	35 262
	1986 - 87	22 989
	1987 - 88	6 823

Table - No.22: Amount of Reserves and Production of Gypsum. Data is up to the end of August for the fiscal year 1987 - 88

Extension Thayetmyo Cement Factory, 1985).

The gypsum is massive gray with black streaks and is delivered in boulders of up to about 70 cm size to cement plants.

Reserves

Amount of Reserves and production data of gypsum is shown in Table No. 22.

2.2.6 Hematite

It is not necessary to use hematite as correction component for raw-mix.

During the Field Mission a sample of hematite was received and chemically analysed. Results of analysis are shown in the Table No. 23.

X-Ray and DTA analyses have proved presence of goethite and quartz.

No detailed information on hematite resources was acquired.

Sample	Source of analysis	Chemical composition in %											
		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	MnO	P_2O_5	Na_2O	K_2O	SO_3	L.O.I.
LH - 4	B	14,79	5,30	67,08	0,204	0,04	0,18	0,017	0,13	Tr.	0,35	Tr.	10,78
NAM-HPAT	A	2,60	4,29	79,79		1,80	0,41						11,09

Table - No. 23 : Chemical composition of hematite of the NAM - HPAT deposit.
Explanations: A - Source of analysis - Ministry of No.1 Industry, C.I.C.
B - Analysis by Geological Survey, National Enterprise, Spišská Nová Ves.

3. RAW-MIX CALCULATIONS

The objective of the Feasibility Study is setting up a plant to produce Portland cement.

As coal (lignite) of low calorific value and considerable content of volatile matter is considered as fuel for clinker burding, a dry process in a short rotary kiln with preheater is proposed. Production of a shaft kiln cannot be selected due to the properties of coal. Similarly, wet process of production in a rotary kiln will not be adopted due to outdated and poor economy features of technology.

Estimated production of the mini-cement plant is 210 tons per day (63 000 tons per year).

Estimated consumption of raw materials (natural state) is 261 tons of limestone, 74 tons of clay and 3 tons of ash (per day).

The plant will be characterized by a dry-process short rotary kiln with preheater. The plant will produce a standard cement conforming the specifications of B.S. 12; 1978, UDL 666.942 : 691.542.

Taking account of selected technology and equipment, the following quality criteria for raw-mix composition were determined:

S_{LP}	=	96 - 103 (two component raw-mix)
MS	=	2,5 (three component raw-mix)
K_2O+Na_2O	=	1,3 % max.
Cl	=	0,05 % max.
SO_3	=	1,0 % max.
MgO	=	6,0 % max.
MnO	=	5,0 % max.
P_2O_5	=	0,5 % max.
Sr	=	0,01 % max.
Cu	=	0,01 % max.
Zn	=	0,01 % max.
Pb	=	0,01 % max.

A_S = 0,01 % max.

In determination of raw-mix composition, the following components of raw material were used:

a/ limestone

b/ clay

c/ sand

Based on assessed content of harmful components these should not cause any troubles during production of cement.

Raw-mix calculation alternatives show the two component raw-mix (limestone, clay) is the most suitable due to the properties and qualities of the individual components.

Limestone from $1C_2$ block of reserves was taken as basis for the raw-mix calculations. Clay from the test trench dug out in the vicinity of the TP-2 test pit (sample LL-5) was taken as the basis for the raw-mix calculations. For the case of the three-component raw-mix, the analysis LS-1 of SE-ENG sand will be used.

The fourth component entering into the raw-mix, is coal ash. It is represented by chemical analysis of LU-4 sample (taken during the Field visit from the middle seam of the NAMMA coal mine).

Calculation of the raw-mix was carried out in the following alternatives (Table No.24, 25, 26 and 27).

Taking account of chemical composition of Portland clinker, high percentage of alite (C_2S) and low content of belite (C S) can be expected in clinker. For these reasons, it is assumed that process of hardening and crystallizing will take place rapidly which may result in high initial strength of cement. Raw mix. is medium and well burnable.

Properties of raw mix	Raw mill feed	Kiln feed	Clinker
Limestone (%)	79,0	78,2	
Clay (%)	20,9	20,7	
Content of CaO (%)	42,2	42,1	65,8
SiO_2 (%)	13,2	13,1	20,6
Al_2O_3 (%)	4,8	4,9	7,6
Fe_2O_3 (%)	1,9	2,0	3,1
L.O.I. (%)	36,4	36,1	
Saturation L.P.	95,90	96,00	
Silicate modulus	1,95	1,92	
Alumina modulus	2,51	2,46	
Content of C_3S			56,02
C_2S			16,80
C_3A			14,94
C_4AF			9,40

Table - No. 24 : Alternative No.1 (Saturation L.P. - 96)

Properties of raw mix	Raw mill feed	Kiln feed	Clinker
Limestone (%)	79,8	79,0	
Clay (%)	20,2	20,0	
Content of CaO (%)	42,6	42,5	66,7
SiO_2 (%)	12,8	12,7	20,0
Al_2O_3 (%)	4,7	4,7	7,4
Fe_2O_3 (%)	1,9	1,9	3,0
L.O.I. (%)	36,7	36,3	1,6
Saturation L.P.	99,94	100,0	
Silicate modulus	1,95	1,92	
Alumina modulus	2,50	2,46	
Content of C_3S			65,34
C_2S			8,17
C_3A			14,55
C_4AF			9,13

Table - No. 25 : Alternative No.2 (Saturation L.P. - 100)

Properties of raw mix	Raw mill feed	Kiln feed	Clinker
Limestone (%)	80,3	79,5	
Clay (%)	19,7	19,5	
Content of CaO (%)	42,8	42,8	67,4
SiO_2 (%)	12,5	12,5	19,6
Al_2O_3 (%)	4,6	4,6	7,3
Fe_2O_3 (%)	1,8	1,9	2,9
L.O.I. (%)	36,9	36,5	1,6
Saturation L.P.	102,96	103,0	
Silicate modulus	1,95	1,92	
Alumina modulus	2,53	2,47	
Content of C_3S			72,01
C_2S			1,99
C_3A			14,28
C_4AF			8,94

Table - No. 26: Alternative No.3 (Saturation L.P. 103)

Properties of raw mix	Raw mill feed	Kiln feed	Clinker
Limestone (%)	80,6	79,8	
Clay (%)	15,0	14,9	
Sand (%)	4,3	4,2	
Content of CaO (%)	43,1	43,0	67,5
SiO_2 (%)	13,4	13,3	20,9
Al_2O_3 (%)	3,9	4,0	6,2
Fe_2O_3 (%)	1,5	1,6	2,5
L.O.I. (%)	36,7	36,3	1,6
Saturation L.P.	99,9	100,0	
Silicate modulus	2,45	2,40	
Alumina modulus	2,56	2,49	
Content of C_3S			70,44
C_2S			6,90
C_3A			12,24
C_4AF			7,60

Table - No. 27: Alternative No.4 (Saturation L.P. = 100; Silicate modulus = 2,5)

4. HYDROGEOLOGY

The MEHAN deposit makes a part of SHAN PLATEAU. The proposed site for setting up a plant lays 970 m a.s.l. and the highest point of the MEHAN deposit is 1 071 m. The landscape has a character of a plateau with chains oriented NE-SW. These are of a cliff pattern. The altitude differences between plains and chains are 150 m.

From the geological point of view, the area is layered by Devonian and Permian carbonates and clayey or sandy--clayey qaurtery sediments.

Carbonates are represented by dark-grey micritic limestones with fissure perviousness. During the inspection of the area the outcrops of limestone as well as flat parts of the landscape showed karst phenomena or morphologic depressions, probably of karst origin.

Clay, or sandy clay (terra rossa) is of red passing to red-brownish colour. It is low pervious or impervious. Its thickness seems to achieve locally more than 10 m to several tens of meters.

The area is drained by a dense network of seasonal creeks. During the inspection of the area, no water stream was observed or no subsoil water was detected inside the test pits.

Seasonal streams which in lower altitudes of the landscape change into NAM-YAO and NAM POWNG rivers making part of the drainage basin of the IRRAWADDY river.

Originally, the NARYAMA and KHA-HNYI water streams had been taken into consideration for water-supply of the mini-cement plant. Both water supply locations were inspected during the Field visit. The NARYAMA yields approx. 120 l/sec. The KHA-HNYI yields some 100 l/sec.

With respect for the selected site, distance and demand for water supply arrangements, the NARYAMA water source is recommended to use.

Physical and chemical analyses of water coming from both streams show it is a soft water, slightly alcalic (ph = 7,6-7,75), without sediments, colour or tarnish.

Both waters are slightly mineralized .nd of chemical type prevailing Ca, Mg and HCO_3 ions.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In November and December 1987 the Consultant´s Team asisigned by UNIDO carried out the Field Mission in order to investigate feasibility of setting up a mini-cement plant in LASHIO, Shan State.

The Briefing Notes for the Feasibility Study determined the objectives of the geological works, as stated below:

- To analyze available information on mineralogical exploration and propose further activities in the limestone and clay deposits.
- Together with Project Office, CID, IPD and the Government department in charge of the geological survey, to work out drilling, sampling and chemical analysis programme.
- To supervise laboratory examinations carried out by CIC in the laboratories and make check analyses of 30 % of the samples.
- To elaborate raw-mix calculations and advise on a most suitable raw-mix to chose.
- Carry out abrasiveness, grindability and burnability tests of the raw-mix.
- To evaluate soil tests for erection of buildings.
- Having analysed the available information it was proposed to draw attention to the MEHAN limestone and clay deposits for the sake of suitability of raw materials for production of Portland cement. A working programme of the sample collection in the deposits was prepared. The sample collection was carried out in order to examine variability of chemical composition of limestone and clay. In order to select a suitable resource of clay, samples from broad environment were collected.

As the original calculations of reserves prepared after geological survey in 1980-1982 indicated no clay deposits, re-evaluation of reserves and their quality in the deposit were made.

On the basis of the said re-evaluation the MEHAN deposit containsfollowing reserves (resources):

Limestone:	19 095 030	tons of reserves
	40 683 541	tons of resources
Clay :	2 348 766	tons of reserves
	112 066	tons of resources

- Qualitative properties of limestone and clay show both types of raw matetials are adequate for production of Portland cement and no correction component is needed.

There is, however, a conciderable variability both in horizontal and vertical direction, therefore the said variability must be identified during the next stage of geological survey.

It was also found out that limestone is good for production of special types of cement (white cement), of lime as well as for other industrial applications.

If required, another component - sand (from SE-ENG) and hematite (from NAM-HPAT) can be used.

For fuel, coal from the NAMMA deposit will be used and its ash will be a further component of the raw-mix.

Chemical analyses of the said raw materials confirmed their siutability for the production of Portland cement.

Selected samples of all components were checked for content of harmful substances (K_2O, Na_2O, Cl, SO_3, MgO, MnO, P_2O_5, Sr, Cu, Zn, Pb, Sb). The results of chemical analyses show contents of harmful substances are very low, therefore the quality of clinker would not be based.

It is, however, necessary to examine content of harmful substances in clay of which little information is available yet.

- During the Field visit of the Team, total of 22 samples of raw materials were collected to be analysed in the laboratory of Central Research Organization,Ministry of No.2 Industry, RANGOON. Eleven samples (50 % of total) were checked - analysed in the laboratory of GEOLOGICKÝ PRIESKUM n.p., Spišská Nová Ves, Czechoslovakia.

By comparison of the basic and check chemical analyses, significant differences in results (clay mainly) of the two laboratories were found.

- It was proved that Portland cement can be produced on the basis of the two-component (three - component) raw--mix. For two - component raw-mix a ratio limestone: clay: :ash of 80:19:1 can be applied (dry basis).

For three - component raw-mix using sand from SE-ENG a ratio limestone:clay:sand:ash of 80:14:5:1 shall be appied (dry basis).

- Physical tests of limestone confirmed favourable properties concerning preparation. Limestone is well grindable (1 286 VTI) as well as the raw-mix.

- Soil of the site is formed by clay sediments with low load-bearing capacity and high compressibility. Before start-up of any civil works a detailed soil survey must be made to determine the best suitable method of foundations.

5.2 Recommendations

It is proposed to carry out additional works in the MEHAN limestone and clay deposit though the identified deposits are sufficient for several decades of quarrying. The actual stage of verification of quantity and quality, interpretation of geological structure do not, however, eliminate possible complications during the process of quarrying. Another reason for materialization of more detailed survey is the fact of unreliability of laboratory evaluation, in particular of clay. Difference between the basic and check analyses is too high.

Materialization of survey works should be made in the area proposed for beginning of quarrying (refer to Map No. 2). It is the north-west part of the deposit limited by sample collection spots LL-4, LL-10, LL-1 and the DH-3 borehole.

This area also includes clay sampling spot LL-5. Vertically, area is specified by contour line 969 m a.s.l. Reserves contained in this block are equal to:

1 127 000 tons of limestone and
160 000 tons of clay.

These quantities are sufficient for 20 years of quarrying.

The objectives of the detailed geological survey will be following:

- Verification of correctness of interpretation of geological structure (thickness of clay, interval limestone refuse, karsting);

- Verification of quality of raw materials both in vertical and horizontal direction;

- Verification of reserves of limestone and clay for some 50 years of quarrying.

In the detailed stage of the survey the following proposals are made:

- drilling of about 10 boreholes (the depth up to 100 m), the whole footage being 600 m
- carrying out the complete sampling and laboratory testing program (about 300 pieces of samples for chemical and physico-mechanical tests)
- making out the topographical map in map scale 1:2000 of the area of 0,5 km^2
- geological mapping in map scale 1:2 000 (0,5 km^2) and in a map scale 1:63 360 (2 km^2)
- in co-operation with the Burmese part to increase representativeness and reliability of laboratory evaluation of raw materials (the special aid). One part of the program

to be executed by another supplier (check analyses)

- carrying out the detailed stage of foundation soil survey for LASHIO mini-cement plant. For the proposal of these works see Annex No.1 of the present Report.

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Annex No. 1

R E P O R T

on Evaluation of Soil Test for
Setting - up a Mini-cement
Plant

L A S H I O, S h a n S t a t e

B U R M A

CONTENTS

1. INTRODUCTION

During November and December 1984, Ministry of No.1 Industries, Ceramic Industries Corparation summed up data of the Mission having visited the area proposed for setting- up a mini-cement plant in the LASHIO Township Environment.

The Mission prepared a report recommending three alternative sites.

The UNIDO Consultant´s Team visited LASHIO in December 1987 in order to evaluate suitability of the proposed sites and carried out essential inspection of the locality. During the inspection two test pits were dug out at two most suitable sites which did not, however, give reliable information on soil character due to the depth of underlying clay.

2. SOIL SURVEY OF SITE AND ENVIRONMENT

The proposed sites are located at the SHAN PLATEAU area at the altitude of 970 m a.s.l. The sites are located at the Southern slope of a chain drawing from E to W. The chain is layered ,mostly by dolomites changing into Devonian and Permian limestone. The land morphology is composed of hills and cliffs protruding 100 to 150 m above the surrounding landscape.

The sites are located approx. 1 km one from another, on a gap two km wide, dipping towards SW.

The gap is situated between the steep cliffs of carbonate layered by clayey plastic sediments of red transforming into brownish colour. On some spots, existence of sand admixture is foreseen. On the top of the clayey sediments a layer of brown/brown-reddish soil 30-50 cm thick can be found.

Morphology of landscape gives assumption that thickness of clayey sediment is considerable, several tens of meters. During geological survey of MEHAN limestone deposit four test-pits 9,15 m deep, 20 to 50 m off the protruding cliffs, were dug out. In none of them the subsoil could be observed.

The subsoil could be observed neither by LTP-1 and LTP-2, test-pits carried out during the Consultant´s Team visit.

It is assumed the subsoil is layered by Devonian and Permian Carboniferous.

Besides the upper Palaeozoic (Devon - Perm) represented, mainly by plateau limestone complex (moulmen limestone and equivalents), the broad environment of the inspected landscape is further layered by Precambrian (chaungy series and equivalents, Jura, Triassic and Miocene - Pliocene sediments.

3. RESULTS OF FIELD INVESTIGATION

Site No.1 is situated 16 km south of the town of LASHIO, more precisely 1 km south of the crossroad and east of the LASHIO - MANDALAY highway. The surface is undulated to some extent. The land is rented to local farmers to grow rice, sesame and sugar cane.

This site is unsuitable for erection of a cement plant due to terrain undulation and unsufficient surface area. Instead, on area on the other side of the LASHIO-MANDALAY highway has been proposed which will be referred to as site No.1A hereafter.

Site No.2 is situated 15 km south of town of LASHIO at the crossroads, west of the LASHIO - MANDALAY highway. The surface is even, slightly declining towards south. Similarly, the land is used for farming (mare growing).

This site is suitable for erection of an industrial unit without any obvious objections.

Site No.3 is situated in the vicinity of the village of NARYARMA. The surface is undulated and the land is used for farming.

This site is unsuitable due to conciderable terrain, undulation and moreover, the land has been taken by the Ministry of Forest some time ago. Instead, an area on the other side of the way is deemed to be suitable, hereinafter referred to as site No. 3A.

The considered site alternatives were scrutinized taking into account decisive aspects of implementation and operation of the project and environmental impacts.

In judgement it was prepared employing the values of analytical method where each criterium is evaluated by a number of points. The selected criteria took into account geological and geographical conditions, distance to raw material deposits, connection to road and facilities and extension of the existing social infrastructure.

The most suitable for setting up the cement plant is site No.1A.

The site is situated one km south to the LASHIO - MANDALAY - NAMMA crossroad and the right side of the LASHIO--MANDALAY way. The altitude is 970 m from the sea level. The selected area for the Project is several times larger than required.

The longitudinal boundary of the site is situated approximately 50 m off the said way. I.E. the access rcad to the plant will be 50 m long.

The land is overgrown with high bush-like plants. The distance between site and the nearest settlement (MEHAN village) is 1,5 km.

4. RESULTSOF SOUNDINGS

At the site No. 2 a test-pit (LTP-1), 3 m deep was dug out. The test-pit has shown the following geological composition:

0 - 0,30 .... dark red-brownish soil
0,30-3,00 .... brown-reddish sandy clay

Two samples, LM-1 (0,30 - 1,50 m) and LM-2 (1,50-3,00 m), were collected and no subsoil water was observed.

At the site No. 1, no test-pit was dug out since the inspection proved insuitability for setting up a mini-cement plant due to the steepish landscape and unavailability of extension of the site, if necessary.

Therefore a substitute site, identified as Site No.1A, was selected and the test-pit (LTP-2) was subsequently dug out. It showed the following geological condition:

0 - 0,40 .... dark red-brownish soil
0,40 - 3,00 ...... brown-reddish sandy clay

Two samples, LM-3/0,40 - 1,50 m) and LM-4 (1,50-3,00 m) were collected. Neither this test-pit showed any traces of subsoil water.

5. RESULTS OF LABORATORY WORKS

Four samples of clay sediments coming from the landscape of interest, were tested in laboratory in order to identify and verify these physical properties (these are shown in Table No.28). The clayey sedimets are medium or superplastic soil (creeping point WL = 37 - 51 %, index of plasticity Ip = 18 - 25 %) of soft or hard consistency (degree of consistency Ic = 0,32 - 0,68).
Apparent density of 2650 to 2660 kg/cu.m. was found at moisture content of 24,6 to 43 %. Results of granulometric analysis show the case of clay (content of grain size below 0,063 m is within range of 71 - 88 %, content of sand grains is

Test pit	Sample No.	Depth m	Source of anal.	Moisture content %	Atterberg limits			Grain sizes				Specif. gravity Cs
					LL	PL	PI	Gravel %	Sand %	Silt %	Clay %	
LTP-1	LM-1	0,30-1,50	A	25,8	40,0	19,0	21,0	—	35	65	-	2,65
	LM-2	1,50-3,00	A B	24,6 28,2	37,0 41,3	19,0 25,4	18,0 15,9	—	40 38	60 60	0 2	2,65
LTP-2	LM-3	0,40-1,50	A	43,0	51,0	26,0	25,0	—	14	86	-	2,66
	LM-4	1,50-3,00	A B	31,0 39,2	47,0 58,7	22,0 39,5	25,0 19,2	—	20 16	80 82	- -	2,66

Table No. 28 Summary of geotechnical properties from laboratory,tests. A-Analysis by Soiltesting Laboratory Construction Corporation,B-Analysis of Geological Survey,N.E.Spišská Nová Ves.

within range 12 - 29 %.

The clayey sediments have following properties:

Volumetric weight, kN/cu.m. .... 18 - 18,9
Internal friction angle, ^{o}........... 0
Total consistency, MPa .... 0,0125 - 0,025
Modulus of deformation,MPa .... 2 - 5

6. DATA ON SUBSOIL WATER, HYDROLOGICAL OBESRVATIONS

The site is located 970 m a.s.l. on a slight gap among chains and cliffs layered by limestone. No accumulation of big quantity of water is assumed even during the rainy season.

At the time of inspection of the Site, this was dry without any occurrence of wet spots.

The landscape is drained by number of creeks, being dry on inspection.

No subsoil water was observed during digging the test--pits.

From the point of view of geological structure, it is assumed that thickness of clayey sedimets covering the carbonate complexes of the SHAN PLATEAU can make several tens of meters. With respect to the thickness and granulometric composition, it is assumed that during heavy rains most of rain water will drain over the surface.

Results of physico-chemical analyses of water and water resources far away from the minicement plant show the case of soft, slightly alcalic, sedimentless and untarnished water. The water is little mineralized with prevailing Ca, Mg and HCO_3 ions.

Considering behaviour of water towards civil structures, this is not harmful. As data on content of CO_2 are not known, no statement of behaviour of water towards steel can be made.

7. CONCLUSIONS AND RECOMMENDATIONS

Since no detailed geological data referring to foundation conditions are available, information as stated below will serve for information, only.

Clayey sediments form soil for foundation of individual buildings. Their bearing capacity is low and they are strongly compressible.

In order to evaluate founding of auxiliary buildings, the bearing capacity of clayey sediments is 0,07 MPa. This value does not respect influence of depth. In case of extreme load, the load-bearing of soil can be increased by substitution of sediments by compacted gravel layer.

When evaluating foundation conditions, a possible impact from non-uniform setting-down of buildings should be taken into consideration. In case where subsoil sediments can continuously get dried due to the operation of the plant, the foundations of the buildings shall be insulated from subsoil due to deterioration of its physico-mechanical properties.

Foundation of each building must be assessed with respect to pertinent load and subsoil layering. For information, evaluation of cement silos seated on hypothetically homogeneous clayey subsoil is described hereinafter.

If load of 57 MN is impressed on a 9 x 24 slab, foundation depth of 3,4 m, load-bearing capacity is gone beyond and subsoil deformation can occur even if subsoil is replaced by gravel layer of 4 m and floating piles foundations, 5 m long, are used. Shaft columns shall be used for foundations. Number and size of the columns have not been assessed due to unknown subsoil geological structure.

It is, therefore, proposed to proceed in exploration by making 8 boreholes ending 2 m deep in rocky subsoil. The boreholes 30 - 50 m deep, as per assumption, will be good for evaluation of sequence and thickness of individual layer down to rocky subsoil as well as for evaluation of physico-mechanical properties of soil. It is further proposed to collect 28 samples out of the said boreholes in order to carry out following tests:

- for each sample: moisture content, liquid limit plasticity limit, volumetric weight, density, grain size distribution
- for 10 samples: deformation index
- for 10 samples: UU triaxial test

LASHIO CEMENT FACTORY – BURMA

Scale - 1 : 1000

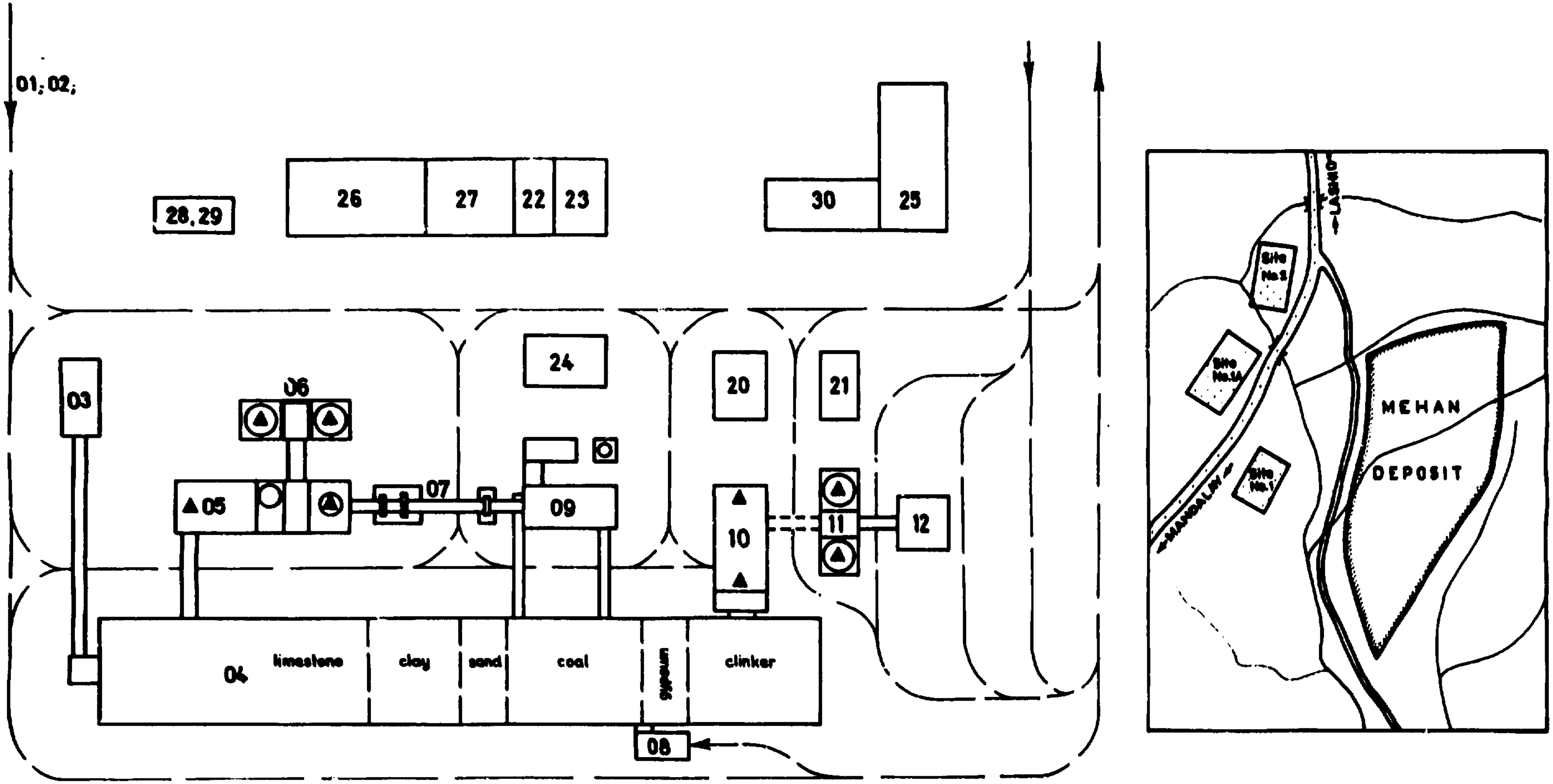


FIGURE:
EXPLANATIONS: 01 - limestone & clay quarry; 02 - sand & hematite extraction; 03 - raw materials crushing;
04 - storage; 05 - raw grinding; 06 - homogenizing; 07 - clinker burning & cooling; 08 - gypsum & coal crushing;
09 - coal grinding; 10 - cement grinding; 11 - cement storage; 12 - cement packing & loading;; 20 - substation;
21 - diesel power station; 22 - compressed air suply; 23 - heating; 24 - water suply; 25 - laboratory; 26 - workshop;
27 - stores; 28 - diesel oil store; 29 - lubricants store; 30 - garage; ▲ - proposed bore-holes;

Annex No. 2

Evaluation of Properties and Suitability of Raw Materials for Production of Cement in

L A S H I O, S h a n S t a t e
B U R M A

LIST OF CONTENTS

1. DESCRIPTION OF RAW MATERIALS

L i m e s t o n e - was represented by a compound sample prepared from LL-7,-8 and 10 samples. It was a case of homogenous, dark-grey, high-quality limestone.

C l a y - was represented by a compound sample prepared from LL-5 and - 6 samples. It was a case of dark-ochre, low-strength, hand-grindable clay.

C o a l - was represented by a sample collected at Namma deposit, middle layer, which was not identical with LU-2 and LU-4 samples. It was a case of brown-black disintegrated, splitting over the plane and hand-grindable coal.

2. GRINDABILITY - PREPARATION OF RAW MEAL

Grindability of limestone was assessed by the VTI method. Grindability of clay was not assessed due to inadequate standard granulometry.

Grindability of limestone is 1,286. Hence, it is a case of an easily-grindable limestone (above 1,200 - easily grindable, 0,0800 - 1,200 - medium grindable, below 0,800 - heavy grindable). Samples of limestone and clay were ground to 15 % of residue on 009 sieve (expected operational conditions).

A sample of coal was crushed, ground and burt at 800°C to ash.

Coal is an actual type of combustible. Its calorific value in dry condition is 24,47 MJ per kg^{-1}. Its calorific value in natural condition is 17,71 MJ per kg^{-1}. Specific heat consumption is estimated at 3977 kJ per kg of clinker. Ash proportion in raw meal is estimated at 1,04 %.

All raw materials were chemically analysed. The results of the respective analyses are shown in Table No 29.

Based on chemical analyses of raw materials, calculations of two-component raw-mix including coal ash, taking into account SLP value of 94 to 102, were done. A two-component raw-mix selected due to requirements on siple operating conditions.

Percentage of individual componets, calculated chemical and mineralogical composition and properties of clinker are shown in Table No 30.

Raw-mix was homogenized and ground in a mill to 12 % residue on a 009 sieve.

3. BURNING OF RAW-MEAL-PREPARATION OF CLINKER

Raw-mix was mixed with water to dough from which Ø 5-7mm pellets were prepared to burn. Burning was performed in the LEITZ-WETZLAR glow microscope. End of sintering phase (chart in Figure No 4) was observed at 1 420°C. Rate of shrinkage of the tested raw-meal was similar to Czechoslovak raw materials. Therefore 1 450°C were considered as burning temperature over 20 minutes when end of creation of clinker minerals should take place.

Pellets were burnt in the Super Kanthal oven using Pt cups at 1 450°C for 20 minutes. Burnt clinker was let cool down in atmosphere.

A grind was prepared from clinker ground to 1-3 mm grains. Mineralogical composition was observed using the Carl Zeiss univerzal microscope, model NU 2, magnification factor of 300. Mineralogical composition is following: C_3S - 60,1 %

C_2S - 7,2 %

fill- 32,7 %

Contents of clinker materials are within the limits applied to standard Portland clinkers.

Clinker was crushed in a micro-crusher to Ø 1,5 mm grains at max., and gypsun was added using rate of 7 % referred to clinker weight. Clinker was further ground in a china grinder.

Prepared cement had specific weight of 3,03 g/cm^{-3} (assessed by titration method) and specific surface of 272 m^2/kg^{-1} (assessed by permeability method according to Blaine-ČSN 72 2114).

Particulars		Chemical analysis	
	limestone	clay	ash
Moisture (%)	0,05	–	–
Loss on ignition (%)	43,04	10,98	0,5
Cao (%)	54,5	0,7	32,42
SiO_2 (%)	0,55	53,47	10,37
Al_2O_3 (%)	0,34	23,22	17,57
Fe_2O_3 (%)	0,16	9,15	7,2
MgO (%)	0,50	0,5	2,39
SO_3 (%)	0,05	–	–
Cl^- (%)	0,0	0,0	0,0

Table - No. 29: Chemical composition of raw materials

Properties	Raw mill feed	Kiln feed	Clinker
Saturation L.P.	101,0 *	101,0 *	
Silicate modulus Ms	1,62**	1,58**	
Alumina modulus Ma	2,51**	2,51**	
Limestone (%)	77,94	77,13	
Clay (%)	22,058	21,829	
Ash (%)		0,0104	
Content of CaO (%)	42,63	42,52	65,83
SiO_2 (%)	12,22	12,20	18,89
Al_2O_3 (%)	5,387	5,51	8,53
Fe_2O_3 (%)	2,14	2,19	3,39
L.O.I. (%)	35,77	35,4	
C_3S			62,048
C_2S			7,437
C_3A			16,87
C_4AF			10,33
100/(100 - Z) = amount of raw materials (kg) / 1kg clinker			1,5480
Ms . Ma			3,975

Table - No. 30: Chemical composition, mineralogical composition and quality of raw-mix (clinker)

Explanations: * Required
** Computed

Properties	Tensile strength	Crushing strength
Strength after 3 days [MPa]	5.62 5.39 5.45	25.6 25.2 26.4 27.6 26.8 25.2
Average		26.13
Strength after 28 days	7.75 7.57 7.69	46.8 46.0 48.0 49.6 44.0 44.0
Average		46.4

Table - No. 31 : Achieved strengths using cement made from raw materials intended for LASHIO cement plant

Deposit period for test bodies			Minimum average strength of cement in MPa by test bodies, cement class					
in wet ambience	in water	Total	325		400		475	
			Bend	Pressure	Bend	Pressure	Bend	Pressure
1 days	2 days	3 days	2,5	13,0	3,5	18,0	4,5	23,0
1 day	27 days	28 days	5,5	32,5	6,5	40,0	7,0	47,0

Table - No. 32 : Minimum average strength of cement in MPa according to ČSN 72 2121

Fraction	Quantity %	Characteristics
> 200 μm	2,28	Fraction consisting of insoluble silicates and pure clay SiO_2 grains occurence is rare.
90 - 200 μm	7,38	Fraction consisting prevailingly of insoluble silicates and pure clay. Minor content of SiO_2 grains.
60 - 90 μm	3,86	Aproximately equal portions of insoluble silicates and SiO_2 grains.
< 60 μm	86,43	From granulometry point of view the whole portion is reacting well.
Total content of quartz grains in clay - 88 %		

Table - No. 33: Determination of content of quartz grains in clay

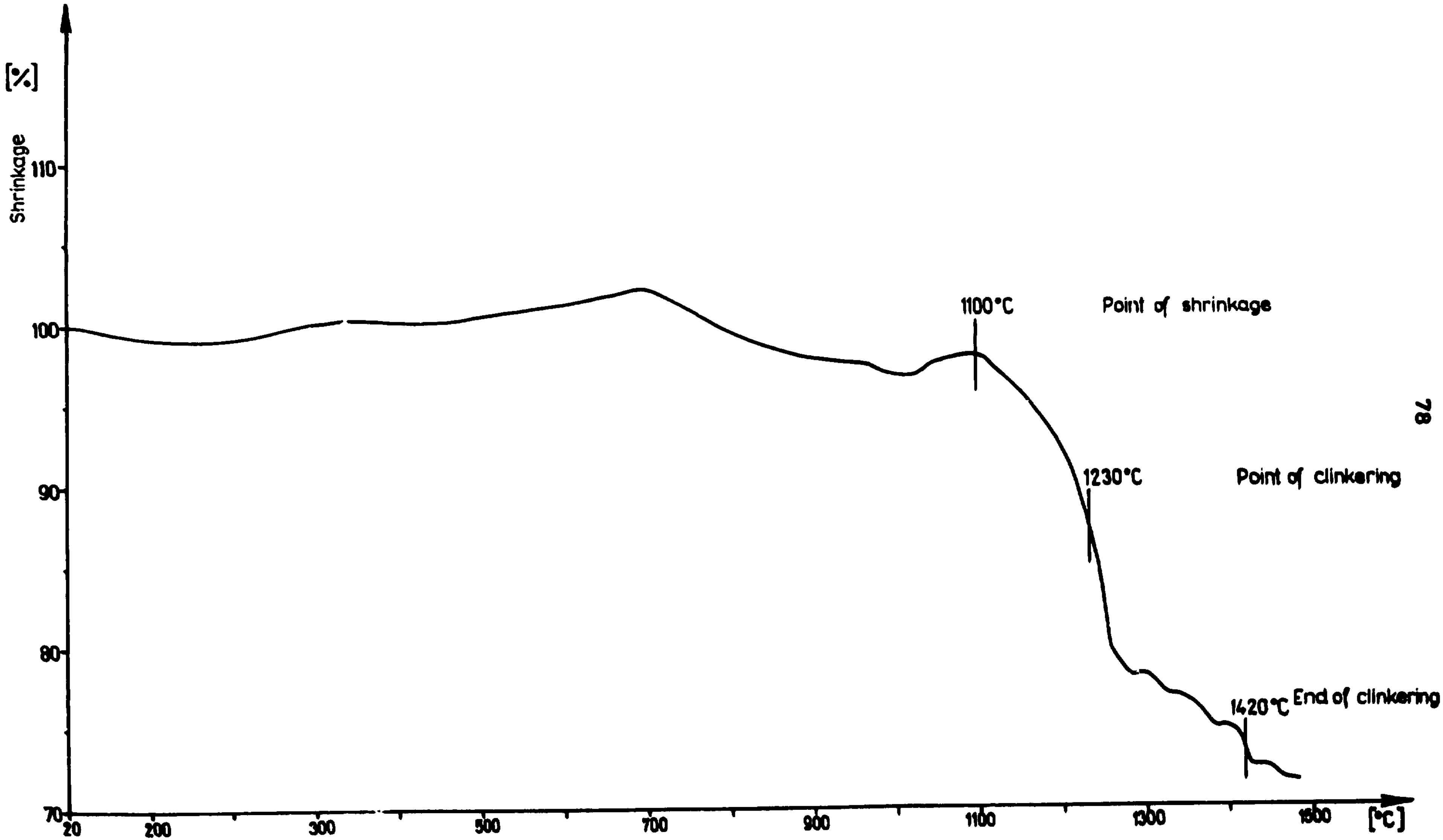

[%]
Shrinkage
110
100
90
80
70
20
200
300
500
700
900
1100
1300
1600
[°C]
1100°C
Point of shrinkage
1230°C
Point of clinkering
1420°C
End of clinkering

Figure - No. 4

Such Portland cement (ČSN 72 2121) of water coefficient according to ČSN 72 2117, was made ready for standard strength tests (bending, compression after 3 and a 28 days). Obtained results are shown in Table No 32.

4. CONCLUSION

Comparing mineralogical composition of the cement laboratory prepared from raw materials from Lashio with Czechoslovak cements, no significant difference was observed.

A standard test methodology (ISO-R-772) was applied for strength comparison. This methodology has been widely employed in the COMECON countries as well as other European countries (France, Germany, etc.). According to this methodology, tested cements can be classified as standard types of Portland cement where a specified class will depend on fineness of grinding. (The finer is grinding, the higher is standard strength).

Burning of clinker proved suitability of used raw materials for burning of clinker showing very good burnability (burning at 1 450°C for 20 minutes yields double moduls of burnability of 3,97).

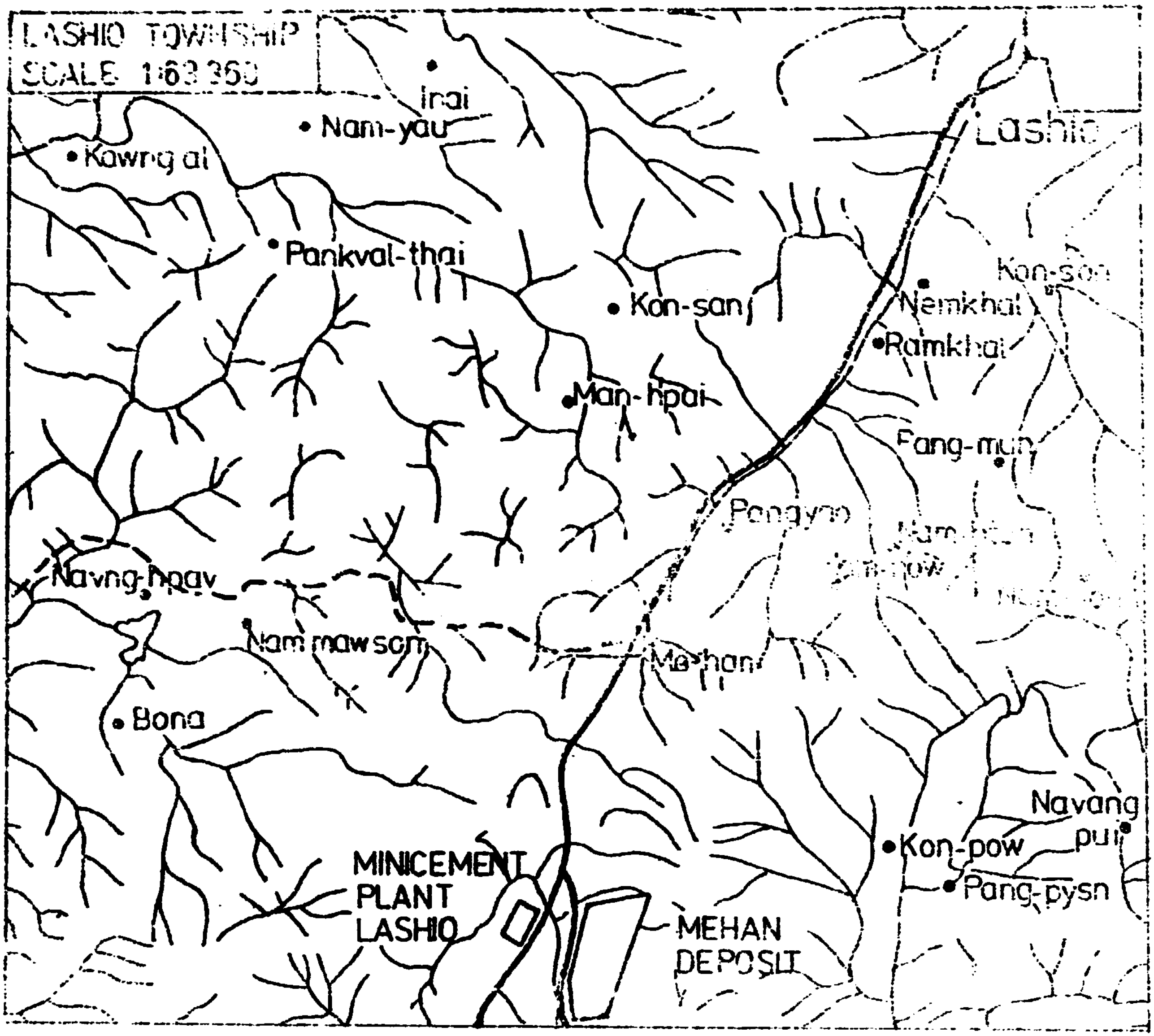
As to reactivity (assessment is based on course of sintering in a high-temperature microscope), this raw-mix is well-burnable confirmed by content of quartz grains in clay (86,43 % of insoluble silicates and pure SiO_2 what is represented by fraction below 60).
This share enters well into reaction during burning process.

Content of quartz grains in clay and their granulometric composition are shown in Table No 33.

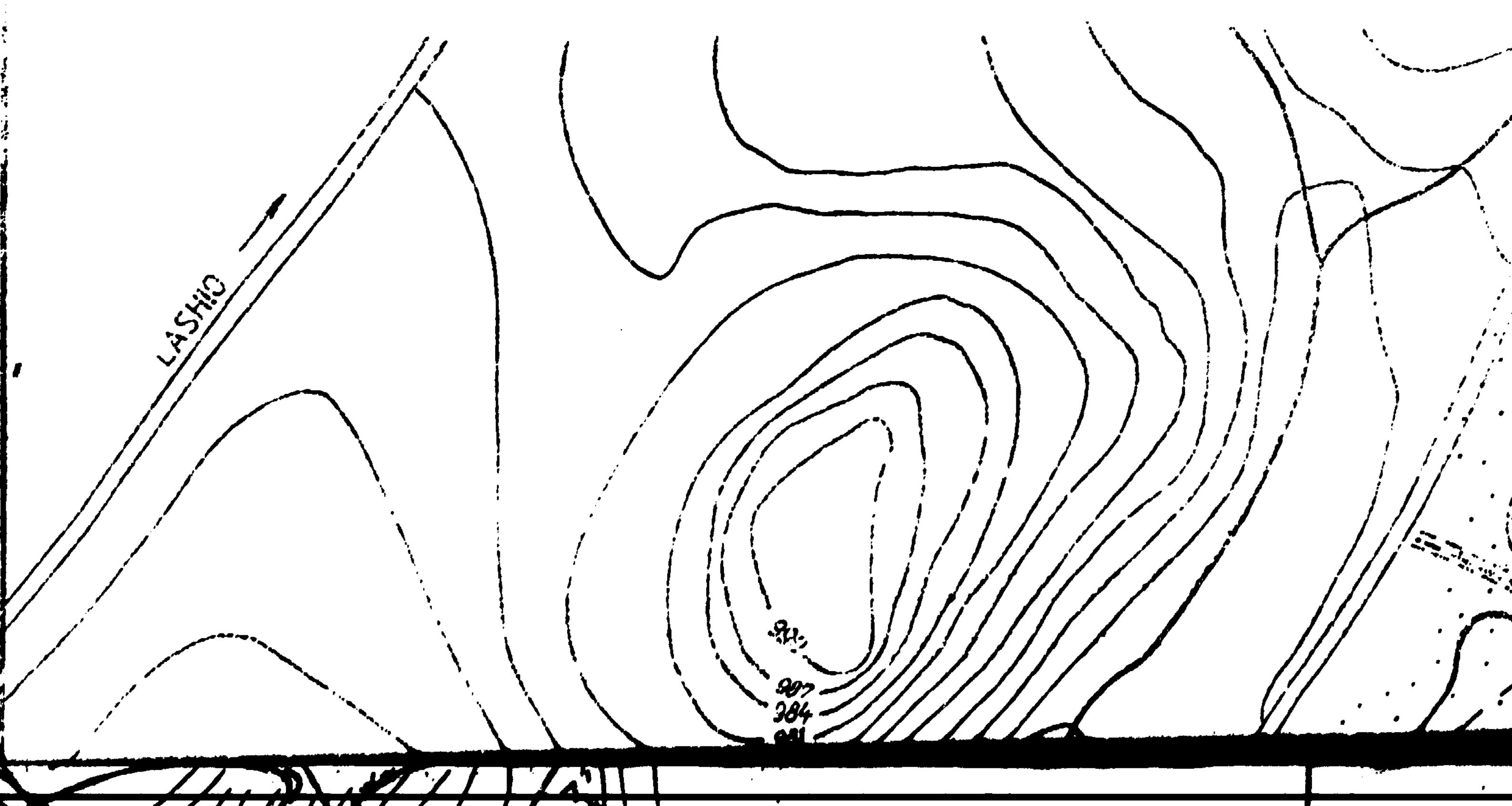
Content of SiO_2 in limestone is low (0,55 %), therefore no problems with free SiO_2 are is presumed.

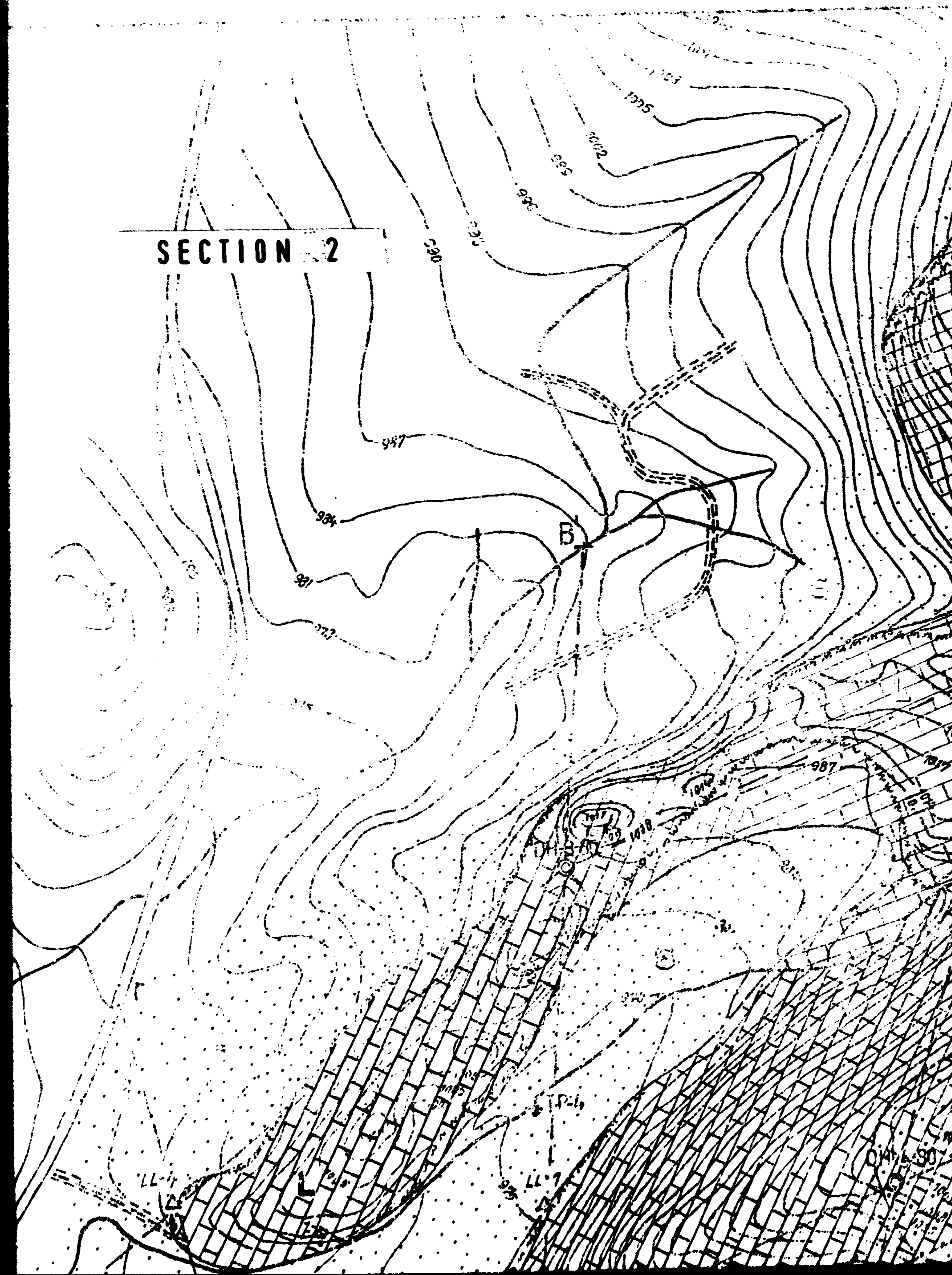
As to mineralogical composition, clinker is also suitable for production of Portland cement of high classes on condition that production parameters, e.g. burning temperature, control of chemical composition, clinker grinding, are closely observed.

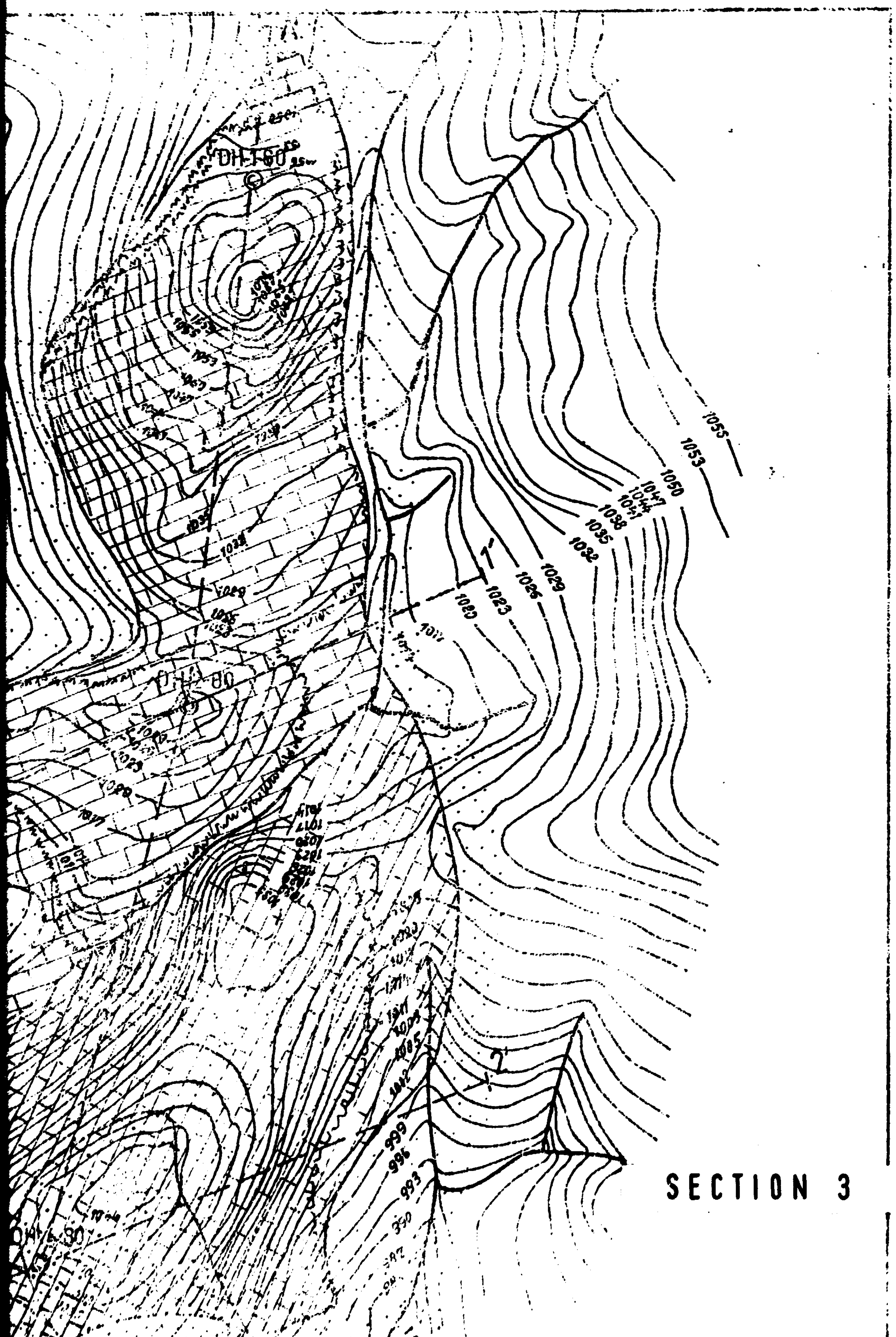
Suitability of the described raw materials intended for use in the LASHIO mini-cement plant was also confirmed by standard cement tests. Compression streingth after 28 days is considerably higher than that required for PC 400 class of cement (ČSN 72 2121).


LASHIO TOWNSHIP
SCALE 1:63 360
Inai
Nam-yau
Kawng ai
Pankval-thai
Kon-san
Lashio
Nemkhai
Ramkhai
Man-hpai
Pang-mun
Pangyao
Navng-hpav
Nam maw son
Mehan
Bona
Navang pui
Kon-pow
Pang-pysn
MINICEMENT PLANT LASHIO
MEHAN DEPOSIT

SECTION 1


LASHIO


SECTION 2
987
984
981
B
987

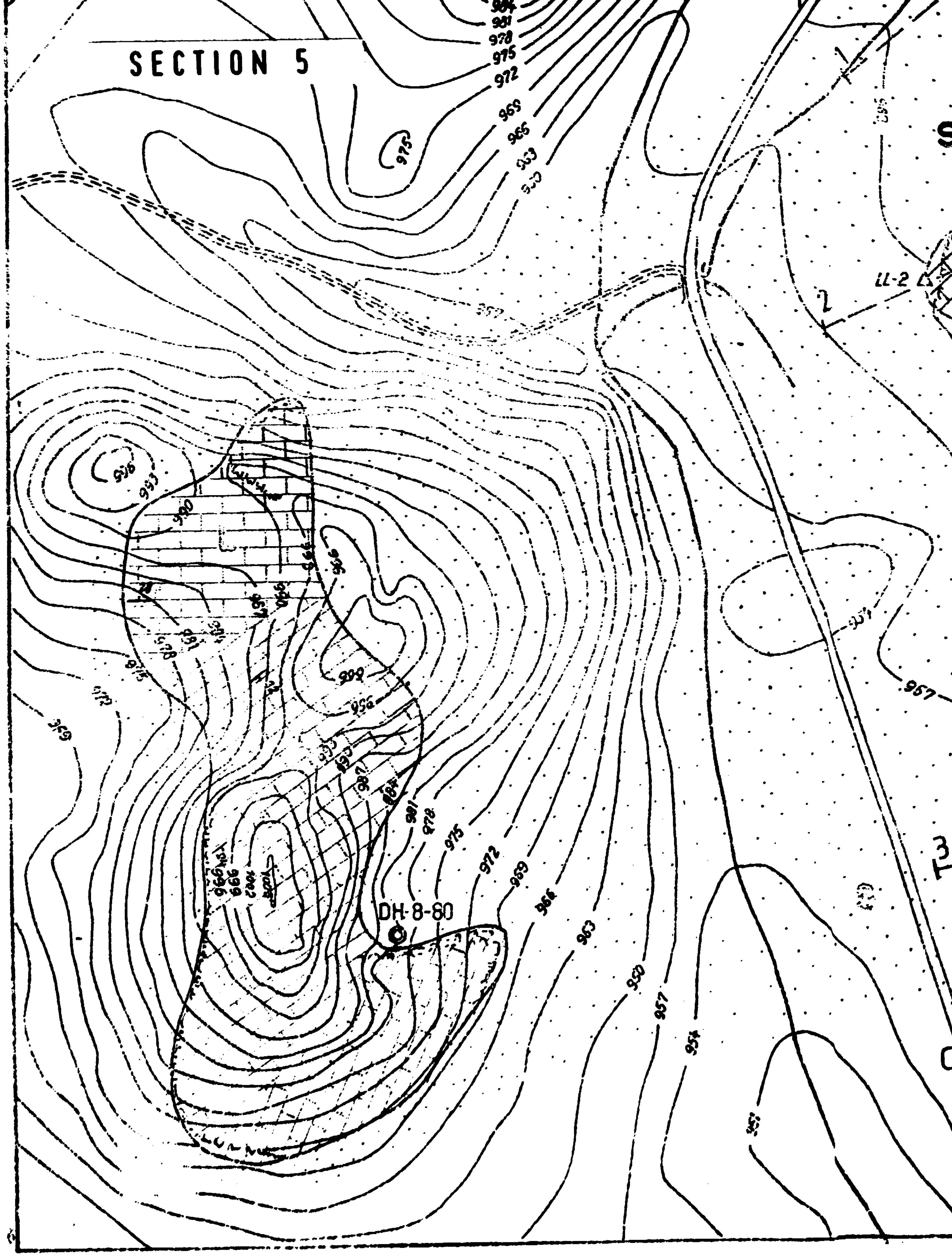

DH-T60
1055
1053
1050
1047
1044
1041
1038
1035
1032
1029
1026
1023
1020
1'
2'
999
996
993

SECTION 3

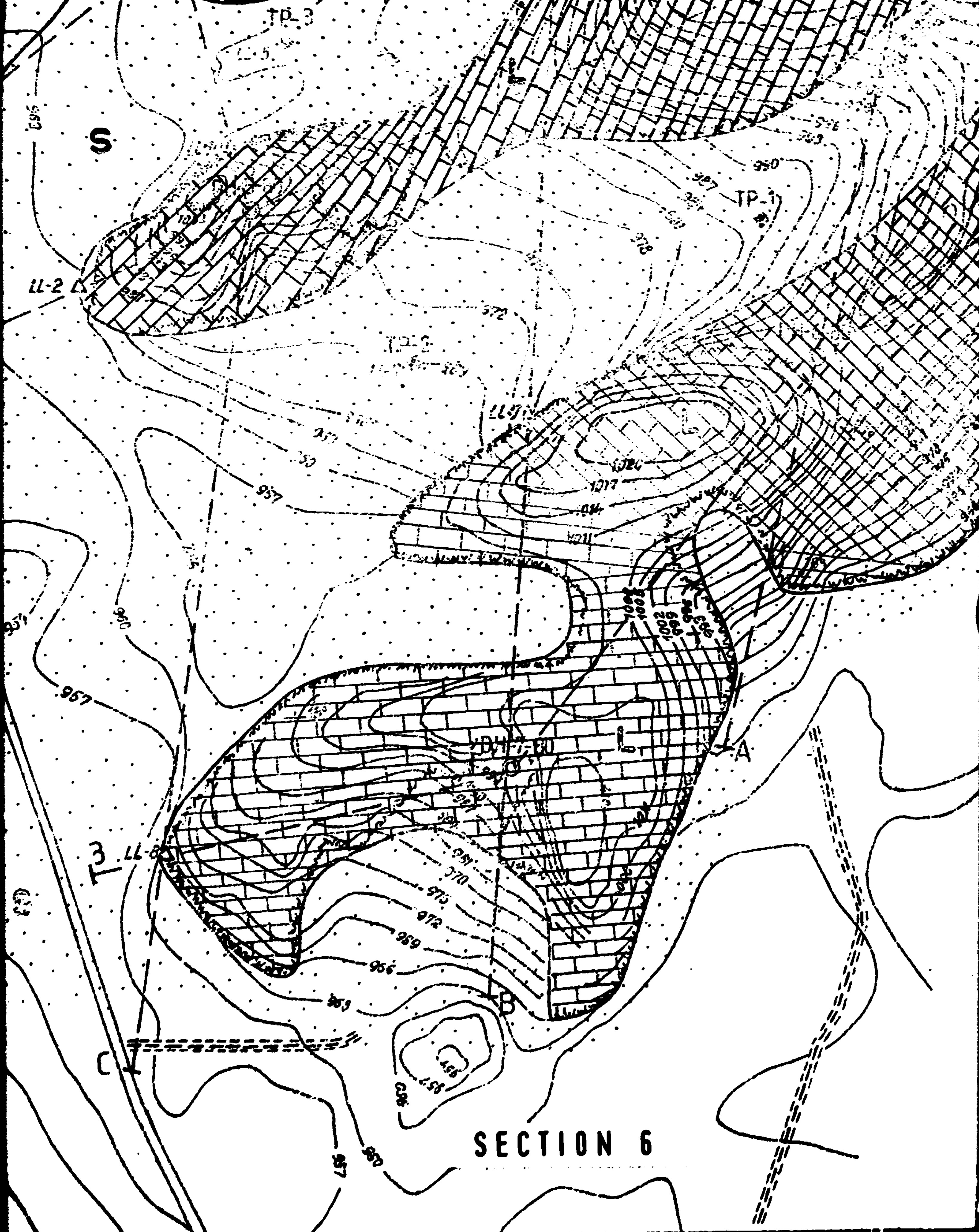
EXPLANATIONS:

	CAR ROAD
	CART TRACK
	STREAM
	CLIFF
969	CONTOUR LINE (in m)
DH-1-80	DRILL HOLE
TP-1	TEST PIT
LL-1	SAMPLE
	SECTION
	OUTCROP, GEOLOGICAL BOUNDARIES
L	LIMESTONE
BL	BRECCIATED LIMESTONE
S	SOIL, TERRA ROSSA
27°	STRATIFICATION (STRIKE AND DIP)

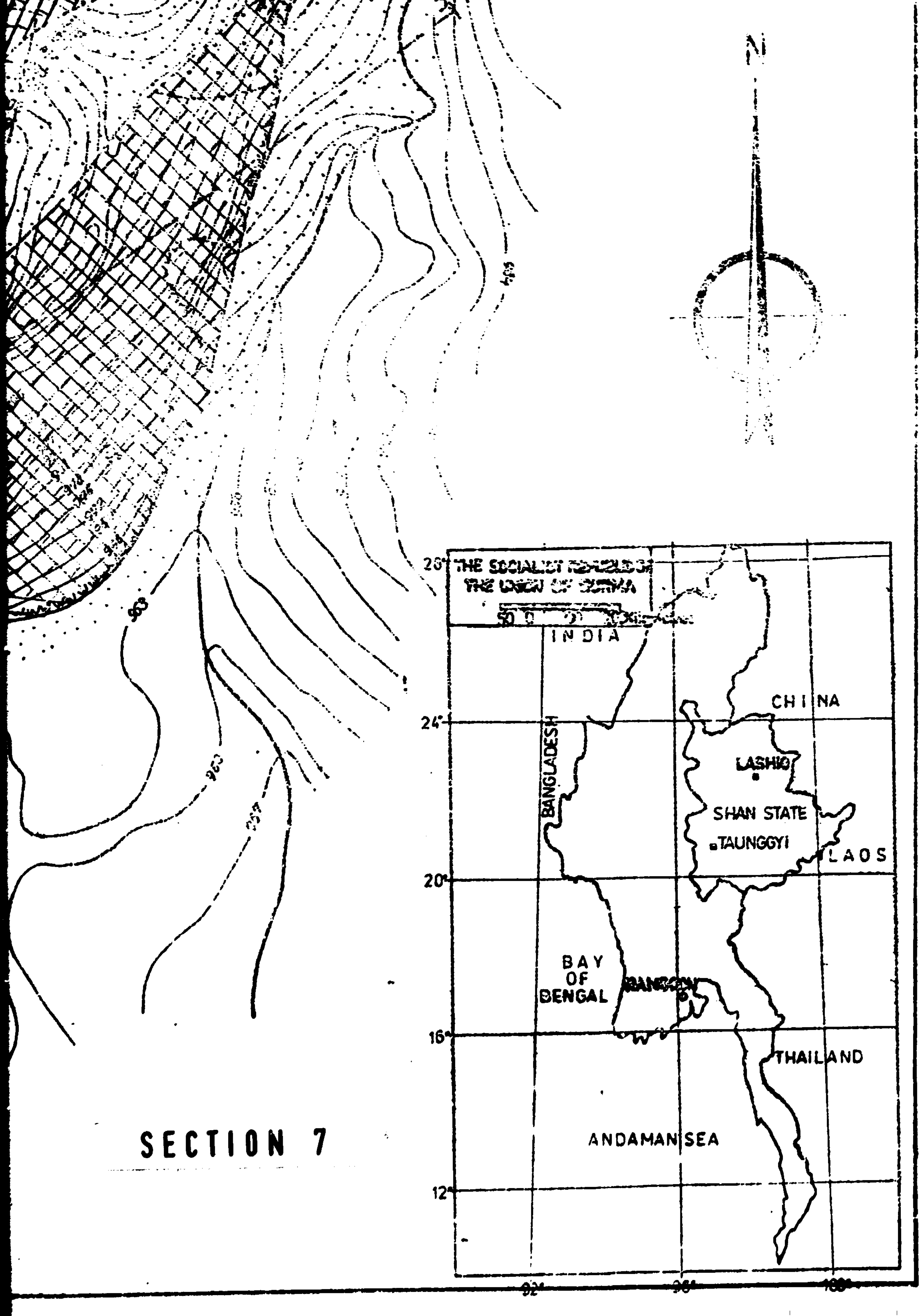
SECTION 4



SECTION 5
984
981
978
975
972
969
966
975
957
996
993
990
984
987
990
993
957
DH-8-80
1002
999
996
981
978
975
972
969
966
963
960
957
954
951
LL-2
1
2



TP-3
S
LL-2
TP-1
DH-7-81
A
B
C
3
LL-8
957
960
966
969
972
975
SECTION 6


INDIA
CHINA
BANGLADESH
LASHIO
SHAN STATE
TAUNGGYI
LAOS
BAY OF BENGAL
THAILAND
ANDAMAN SEA
24°
20°
16°
12°

SECTION 7

SECTION 8

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GEOLOGICAL REPORT FOR THE FEASIBILITY STUDY FOR A 200T/D CEMENT PLANT AT LASHIO, SHAN STATE, BURMA	
FEASIBILITY STUDY	DATA: JANUARY, 1988 — MAP No: 1
PROJECT No DP/BUR/80/015	SCALE: 1:2000
THE SOC. REP. OF THE UNION OF BURMA	AUTOR: S. Mikoláš
POLYTECHNA PRAGUE	DESIGNER: A. Lichnerová
KERAMOPROJEKT TRENČÍN	GEOLOGICAL MAP OF MEHAN DEPOSIT, LASHIO TOWN
GEOLOGICKÝ PRIESKUM SPIŠSKÁ NOVÁ VES	
CZECHOSLOVAKIA	

LIMESTONE - Reserves

Block No.	Bench in m a.s.l.	Limestone in m³	Spec. gravity g/cm³	Limestone in t	Chemical composition in %									
					SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Na_2O	K_2O	M_S	M_A	S_{LP}
$1C_2$	1029	16 727	2,69	44 996	0,892	0,006	0,721	49,840	4,886	0,007	0,016	1,11	0,54	1661,1
	1914	154 305	2,69	415 000	1,072	0,009	0,625	54,166	0,573	0,008	0,047	1,40	6,37	1623,9
	999	472 165	2,69	1 270 070	1,250	0,108	0,510	53,216	1,601	0,008	0,030	1,97	4,00	1207,3
	984	951 537	2,60	2 250 635	2,215	0,150	0,530	53,610	0,444	0,008	0,036	3,00	3,93	766,4
	969	1 465 990	2,69	3 943 513	1,040	0,112	0,060	52,001	1,106	0,009	0,061	1,47	2,10	844,4
	954	1 874 769	2,69	5 043 129	1,447	0,090	0,010	51,061	0,771	0,009	0,030	1,59	9,09	1061,2
	[illegible]	2 163 051	2,69	5 818 607	2,039	0,137	0,616	53,004	1,043	0,009	0,054	2,72	4,40	812,6
Total		7 090 524	2,69	19 095 030	1,790	0,110	0,710	53,322	0,86	0,009	0,048	2,16	6,02	899,7

- Resources

2P		10 861 993	2,69	29 218 761	1,58	0,11	0,7	53,27	0,97	0,009	0,046	1,91	6,36	1017,1
3P		4 262 000	2,69	11 464 780	1,01	0,12	1,06	53,52	0,41	0,010	0,050	1,56	8,67	839,8
Total		15 123 993		40 683 541	1,62	0,11	0,8	53,36	0,81	0,009	0,049	1,78	7,27	960,8

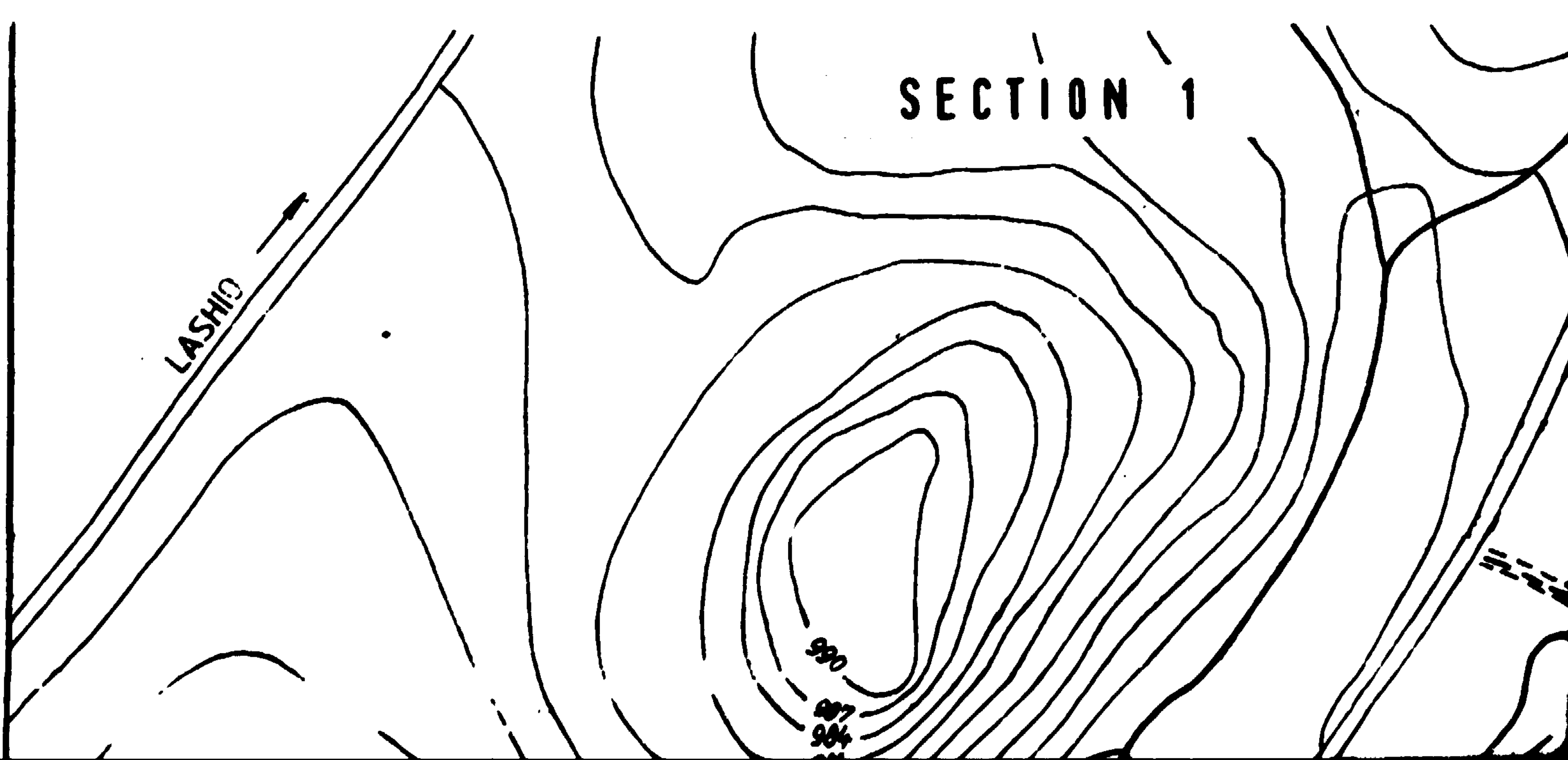
CLAY - Reserves

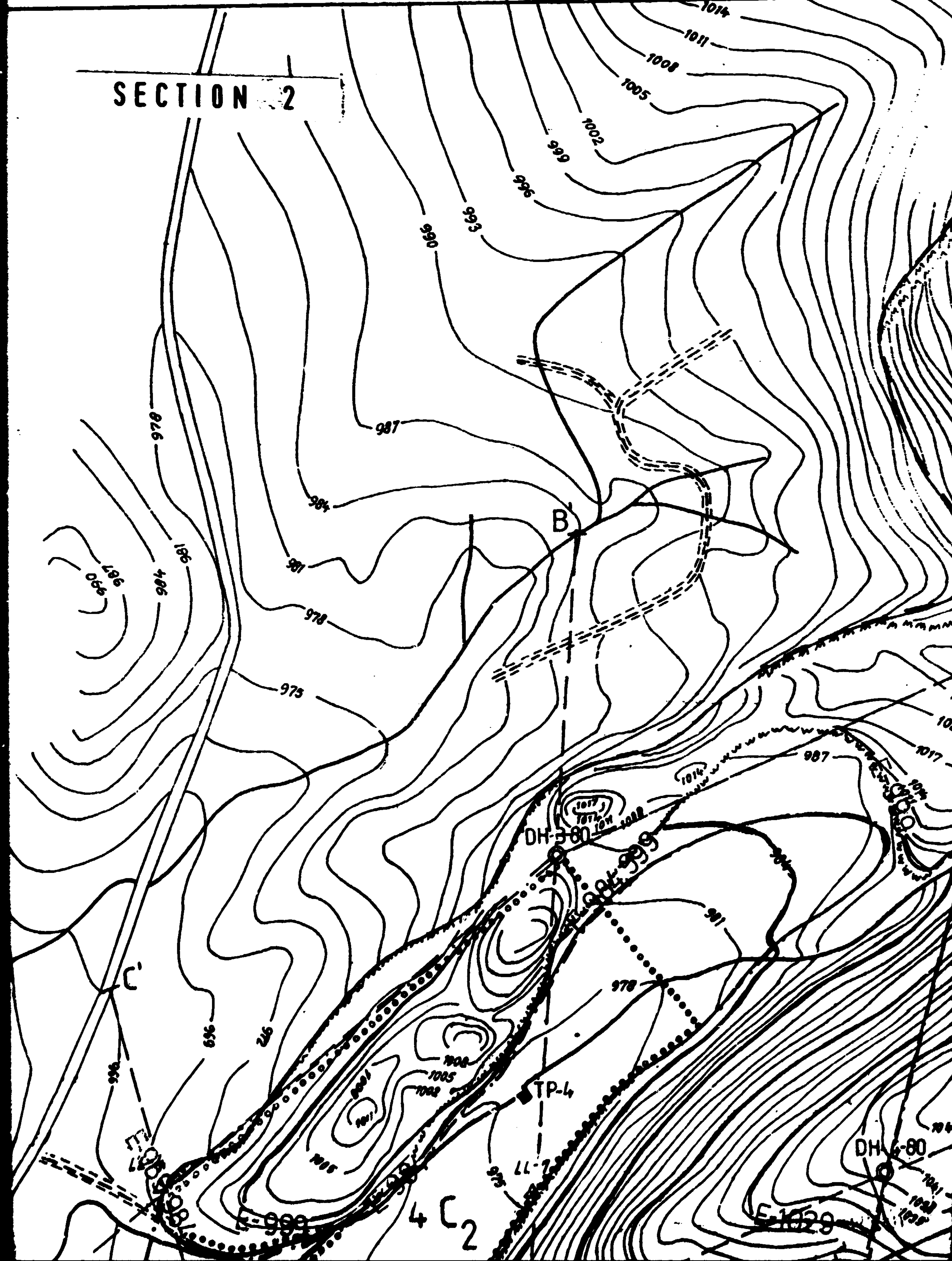
Block No.	Bench in m a.s.l.	Limestone in m³	Spec. gravity g/cm³	Limestone in t	...position in%									
					SiO_2	[illegible]	[illegible]	[illegible]	[illegible]	Na_2O	K_2O	M_S	M_A	S_{LP}
$4C_2$		443 296	2,0	886 592	56,50	8,.	[illegible]	[illegible]	0,53	0,07	1,26	1,92	2,34	0,04
$5C_2$		716 087	2,0	1 432 174	50,50	10,50	23,30	0,17	0,61	0,04	1,12	1,49	2,30	0,10
Total		1 159 383		2 368 766	52,84	9,92	22,28	0,13	0,50	0,05	1,17	1,64	2,25	0,07

- Resources

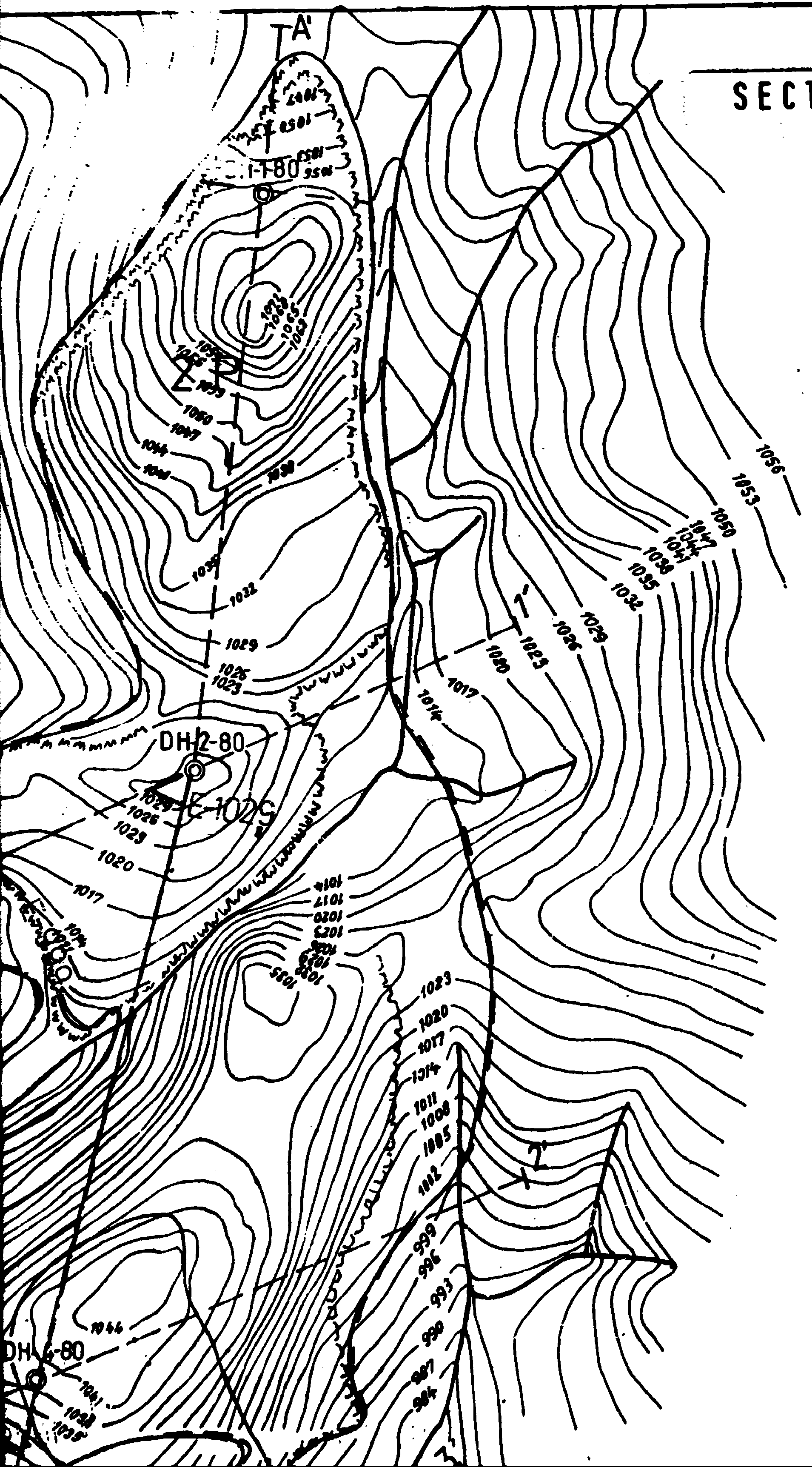
6P		56 033	2,0	112 066	52,84	9,92	22,28	0,13	0,58	0,05	1,17	1,64	2,25	0,07

Reserves /resources/ of limestone and clay of the MEHAN deposit.




SECTION 2
1014
1011
1008
1005
1002
999
996
993
990
987
984
981
978
975
B'
C'
DH-3-80
TP-4
DH-6-80
E-999
E-1029
4 C₂
1017
1005
1008
1011

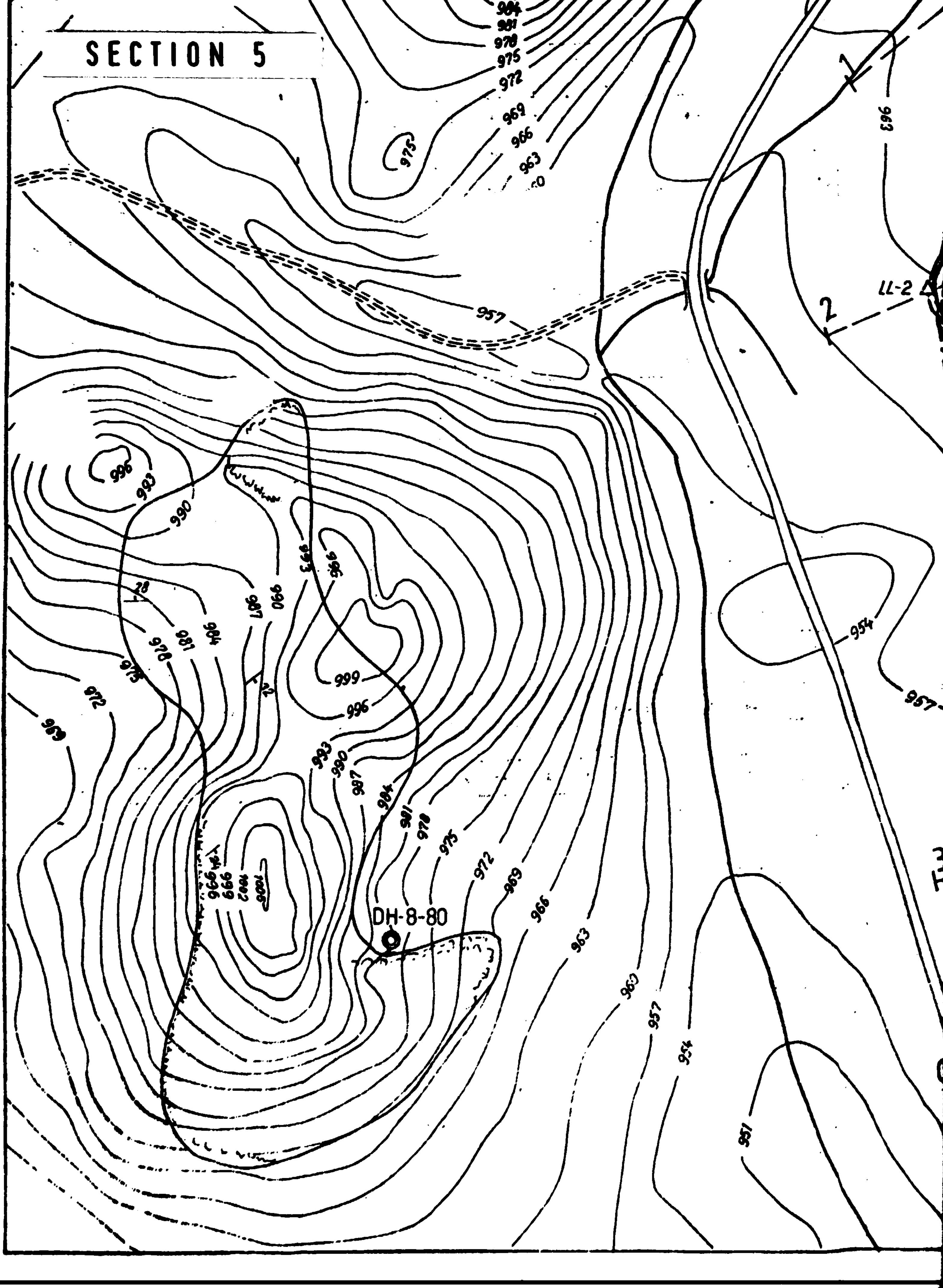
SECTION 3

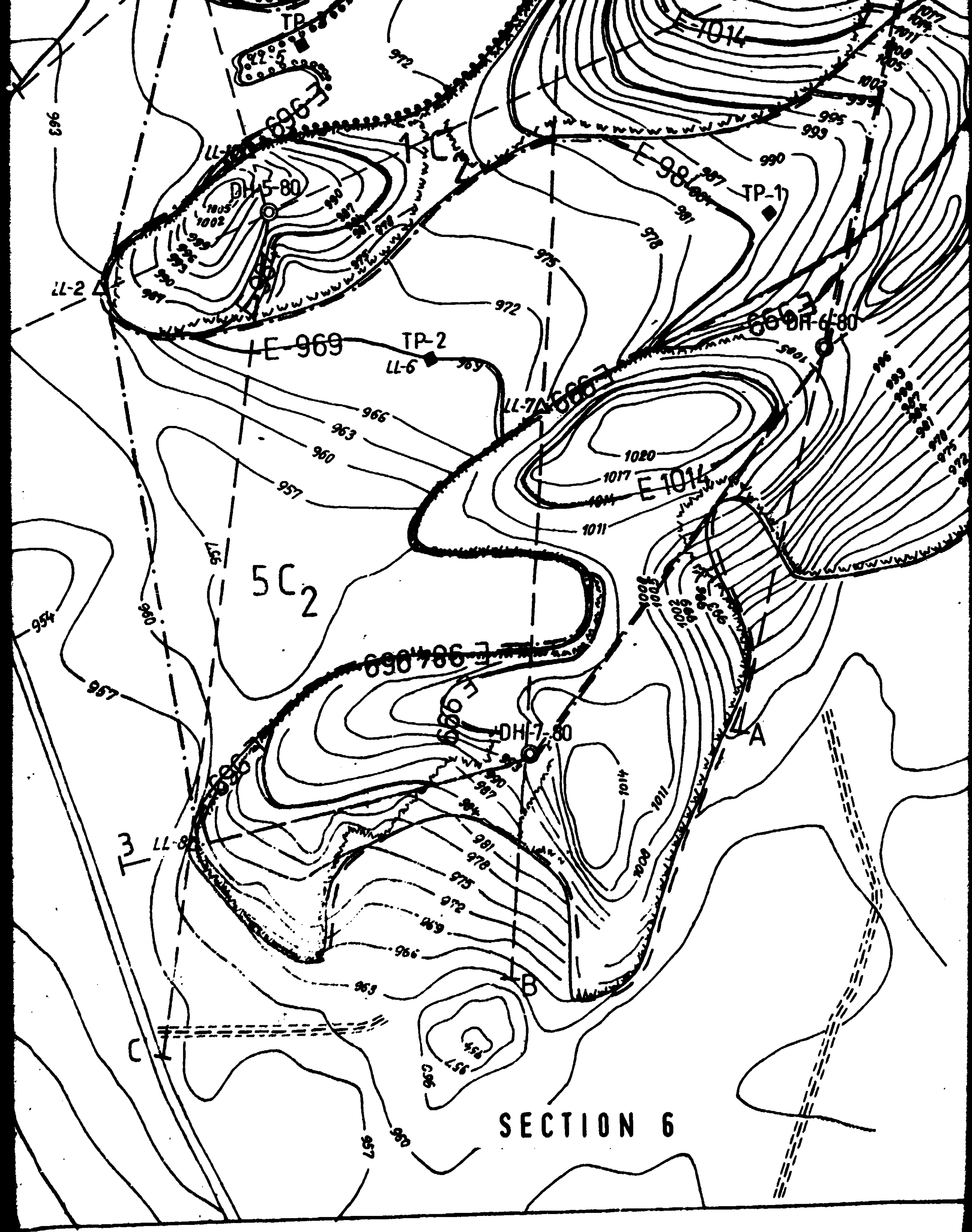


A'
DH 1-80
DH 2-80
E 1025
DH 6-80
1'
2'
1056
1053
1050
1047
1044
1041
1038
1035
1032
1029
1026
1023
1020
1017
1014
1011
1008
1005
1002
999
996
993
990
987
984

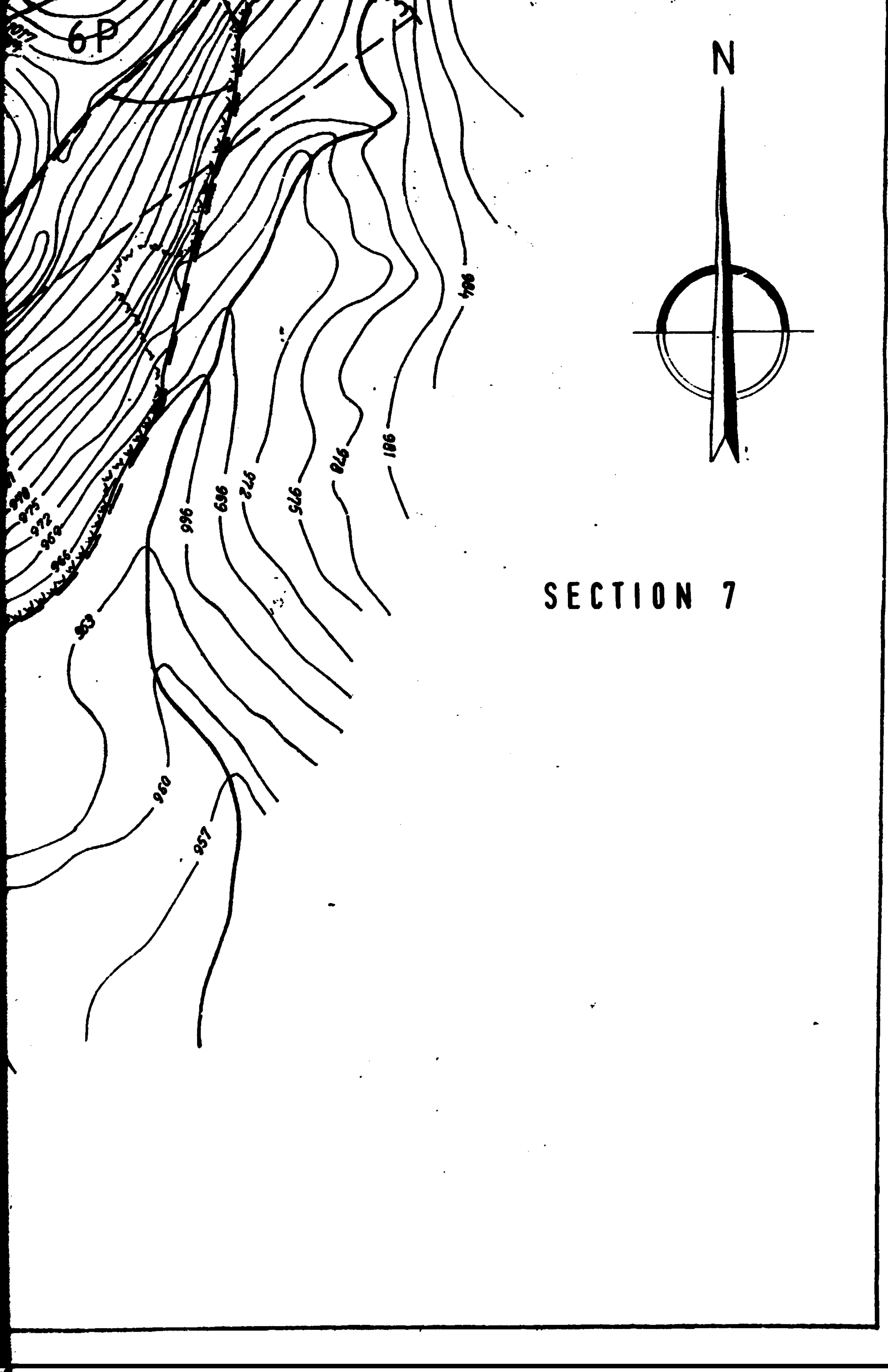
EXPLANATIONS:

	CAR ROAD
	CART TRACK
	STREAM
	CLIFF
969	CONTOUR LINE (in m)
DH-1-80	DRILL HOLE
TP-1	TEST PIT
LL-1	SAMPLE
	SECTION
	OUTCROP, GEOLOGICAL BOUNDARIES
	BLOK OF RESERVES
	BLOCK OF RESOURCES
2 P	BLOCK NUMBER
E-969	BENCH-ALTITUDE ABOVE THE SEA LEVEL
	RESERVES SUGGESTED FOR EXTRACTION


SECTION 5
DH-8-80
LL-2
1
2
996
993
990
987
984
981
978
975
972
969
966
963
960
957
954
951
999
1002
1005



TP
TP-1
TP-2
DH-5-80
DH-6-80
DH-7-80
LL-2
LL-6
LL-7
LL-8
E-1014
E-987
E-969
E 1014
5C2
A
B
C
SECTION 6


6P
N
SECTION 7
963
960
957

RESERVES SUGGESTED FOR EXTRACTION

SECTION 8

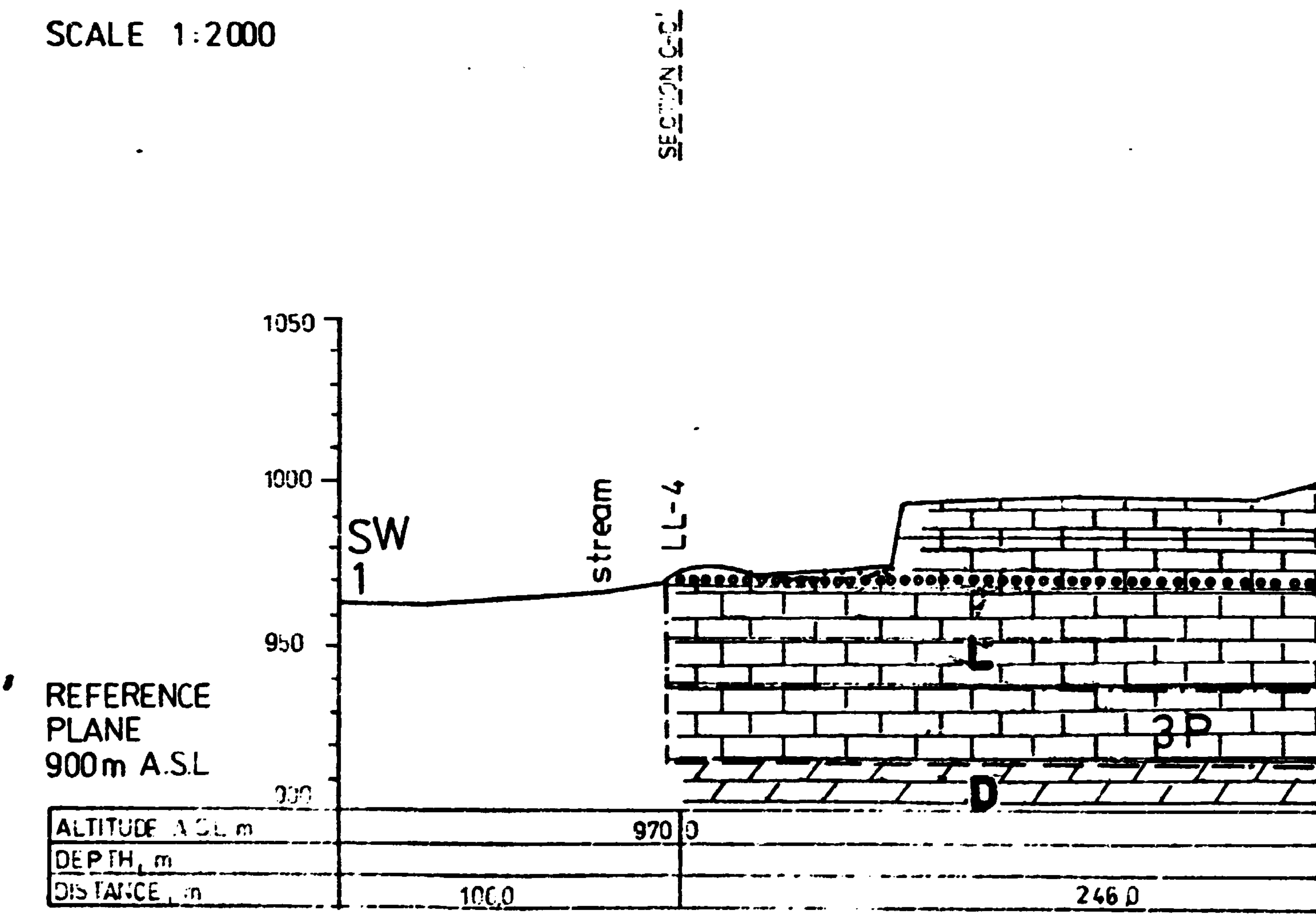
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GEOLOGICAL REPORT FOR THE FEASIBILITY STUDY FOR A 200T/D CEMENT PLANT AT LASHIO, SHAN STATE, BURMA		
FEASIBILITY STUDY	DATA: JANUARY, 1988	MAP: No: 2
PROJECT No DP/BUR/80/015	SCALE: 1:2000	
THE SOC. REP. OF THE UNION OF BURMA	AUTOR: S. Mikoláš	
POLYTECHNA PRAGUE		
KERAMOPROJEKT TRENČÍN	DESIGNER: A. Lichnerová	
GEOLOGICKÝ PRIESKUM	MAP OF RESERVES (RESOURCES) OF THE MEHAN DEPOSIT	
SPIŠSKÁ NOVÁ VES		
CZECHOSLOVAKIA		

SECTION 1

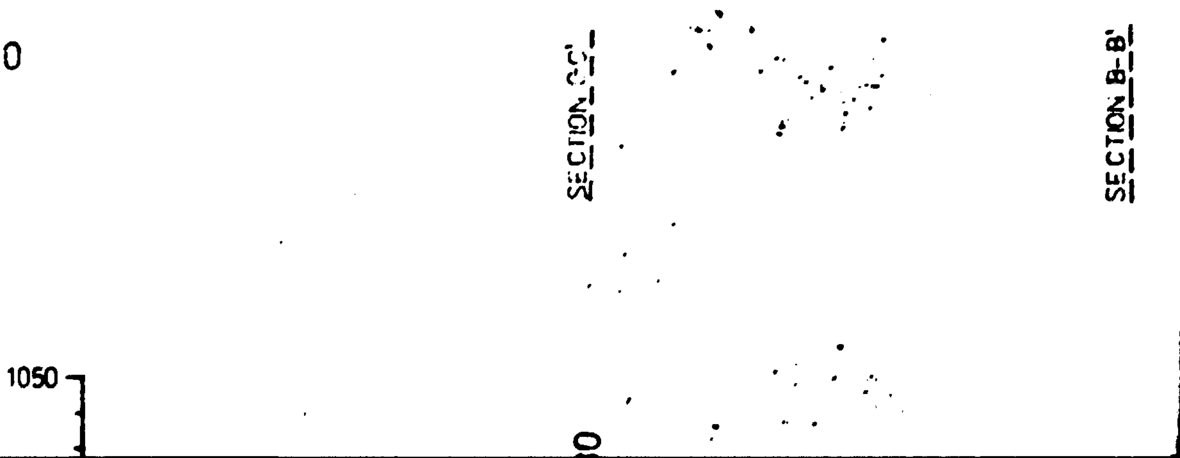
SECTION 1-1'

SCALE 1:2000

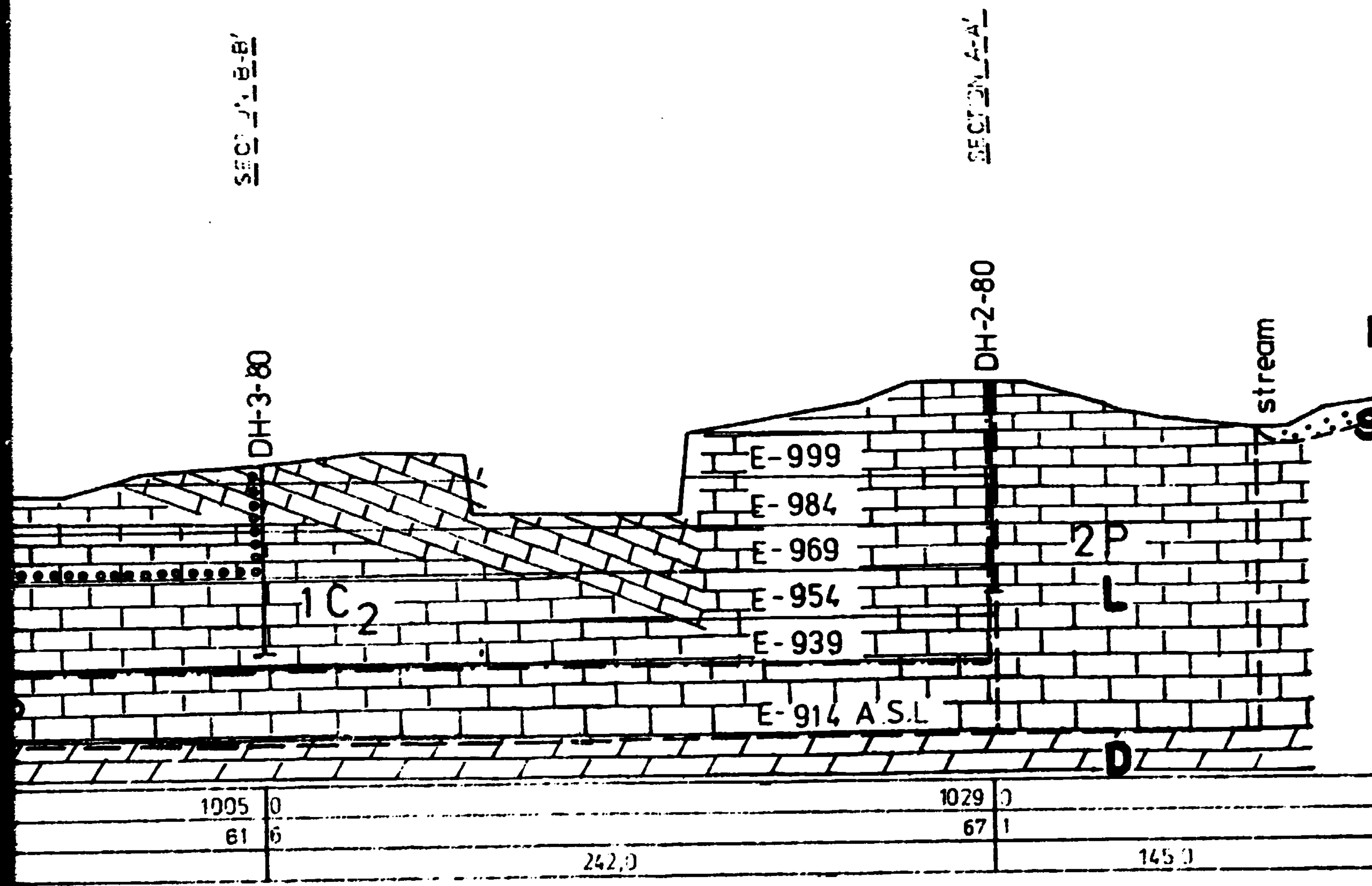


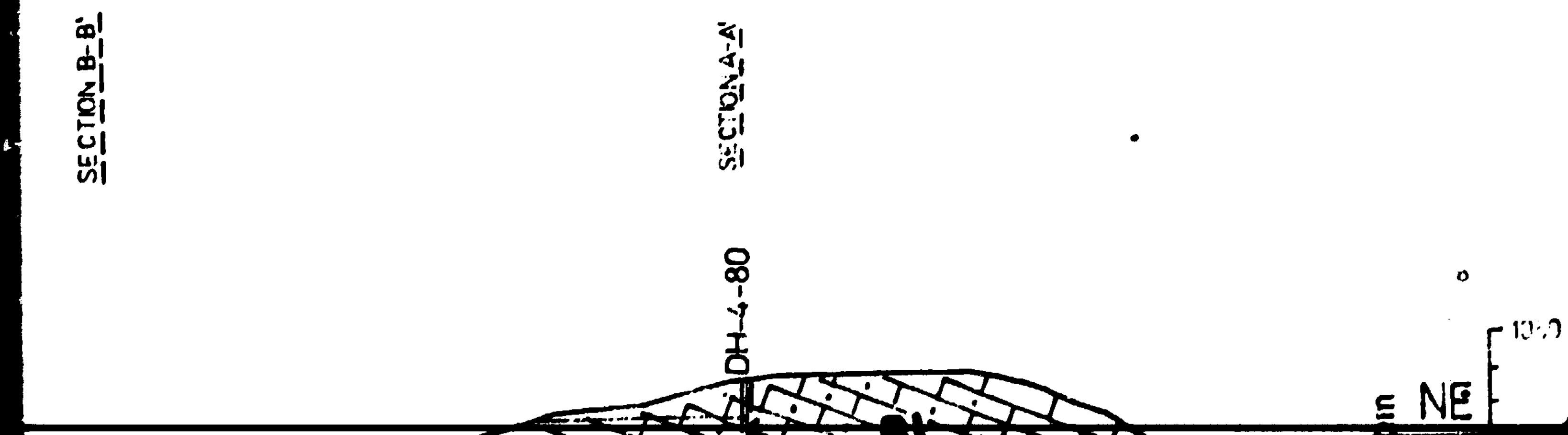
SECTION 2-2'

SCALE 1:2000

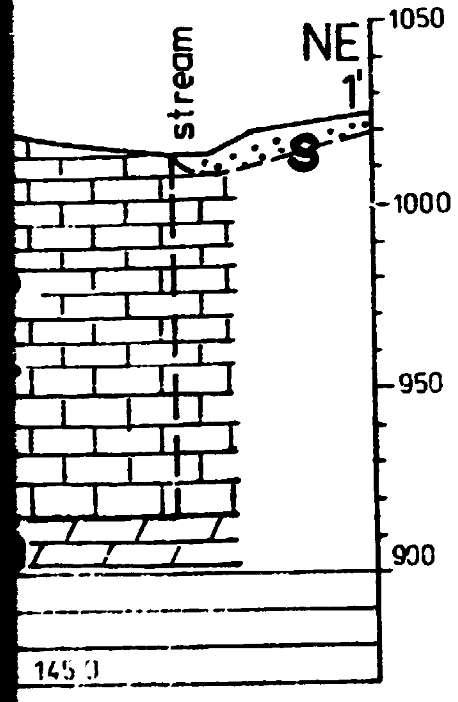


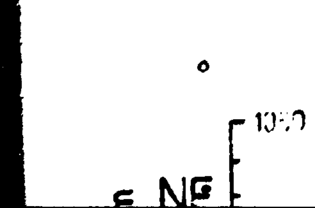
SECTION 2


SECTION B-B'
SECTION A-A'
DH-3-80
DH-2-80
stream
E-999
E-984
E-969
E-954
E-939
E-914 A.S.L
1C2
2P
L
D
1005
61
1029
67
242,0
145,0


SECTION B-B'
SECTION A-A'
DH-4-80
NE

SECTION 3





EXPLANATIONS

DH-4-80 BORE HOLE

LL-1 SAMPLE

1-1' GEOLOGICAL SE

E-914 BENCH-ALTITUD

$1C_2/2P$ RESERVES/RES

BL BRECCIATED LI

L LIMESTONE

S SOIL TERRA RO

D DOLOMITE,DOLO

RESERVES SUGGE

SECTION 4

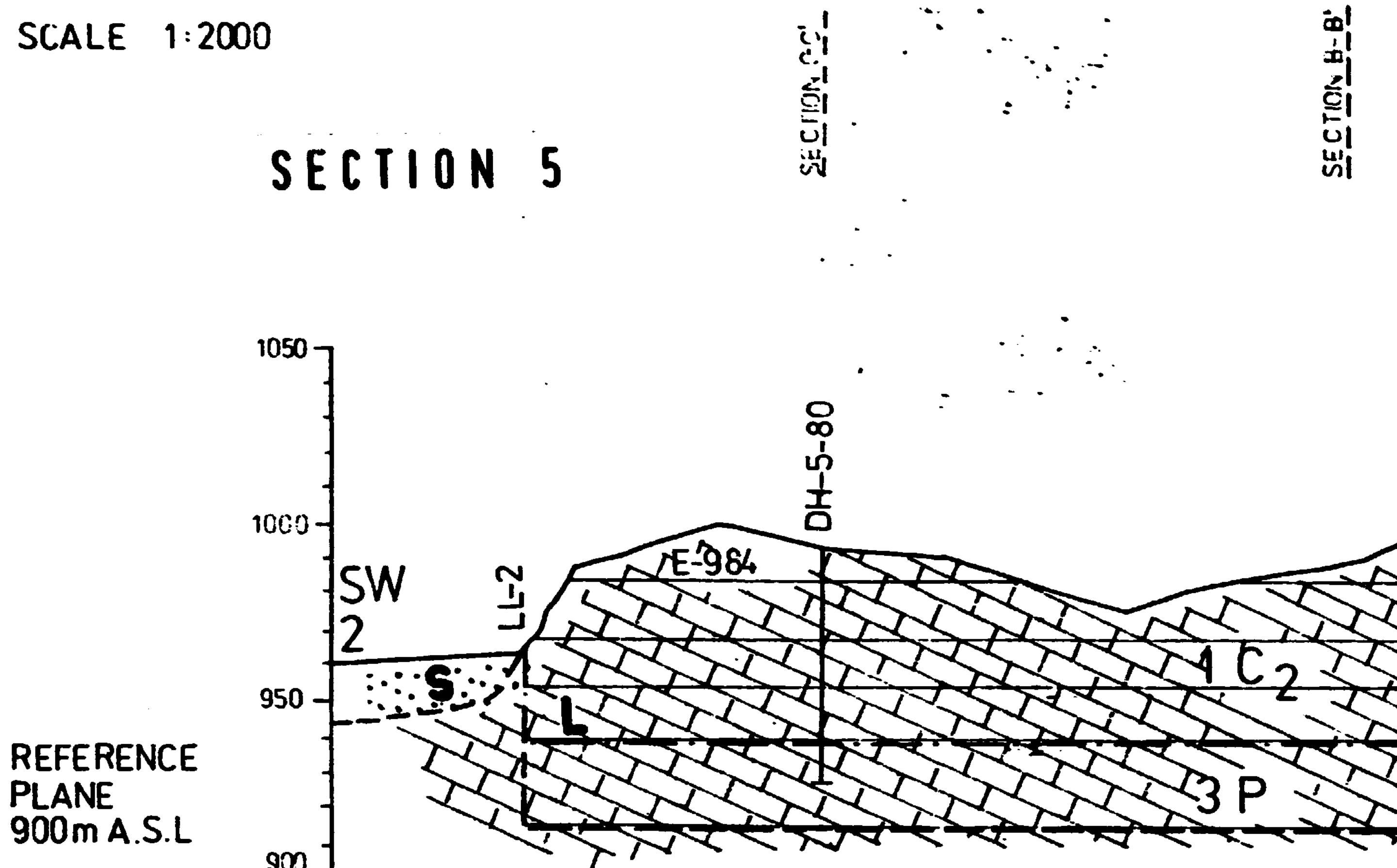
EXPLANATIONS

DH-4-80	BORE HOLE
LL-1	SAMPLE
1-1'	GEOLOGICAL SECTION
E-914	BENCH-ALTITUDE ABOVE THE SEA LEVEL
$1C_2/2P$	RESERVES/RESOURCES
BL	BRECCIATED LIMESTONE
L	LIMESTONE
S	SOIL TERRA ROSSA
D	DOLOMITE, DOLOMITIC LIMESTONE
	RESERVES SUGGESTED FOR EXTRACTION

SECTION 2-2'

SCALE 1:2000

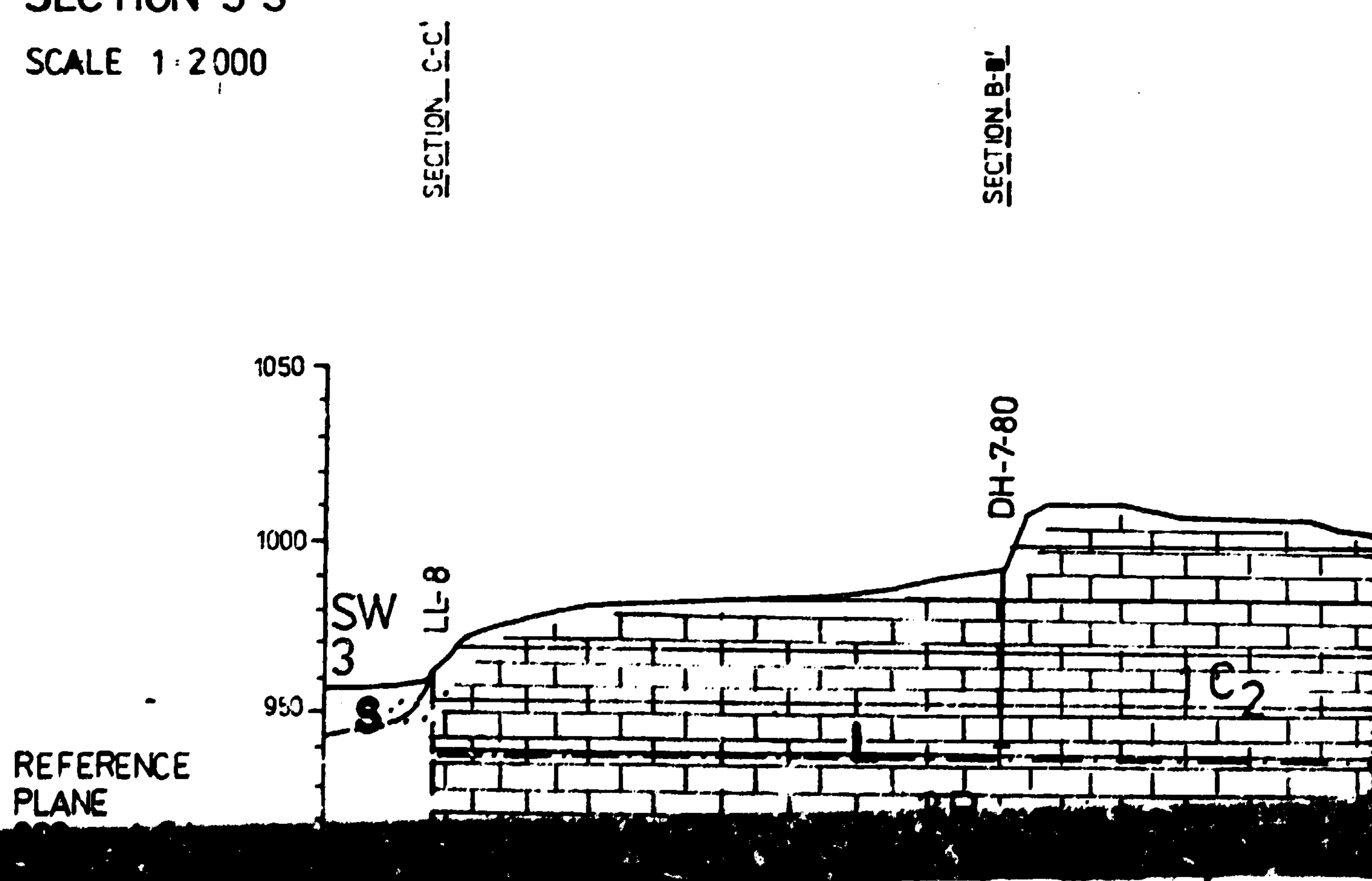
SECTION 5



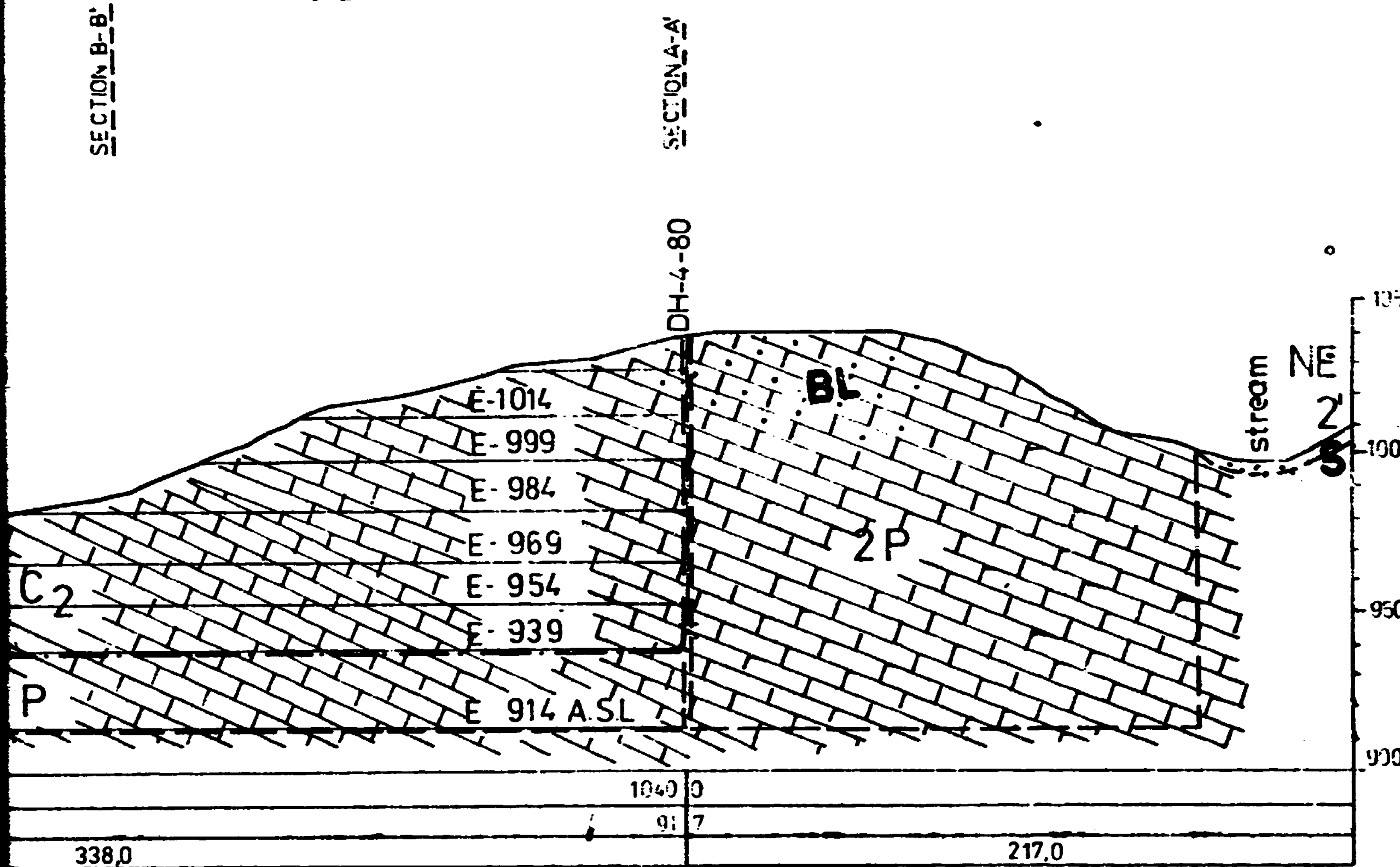
ALTITUDE A.S.L m		993	0
DEPTH, m		66	2
DISTANCE, m	52,0	87,0	338,0

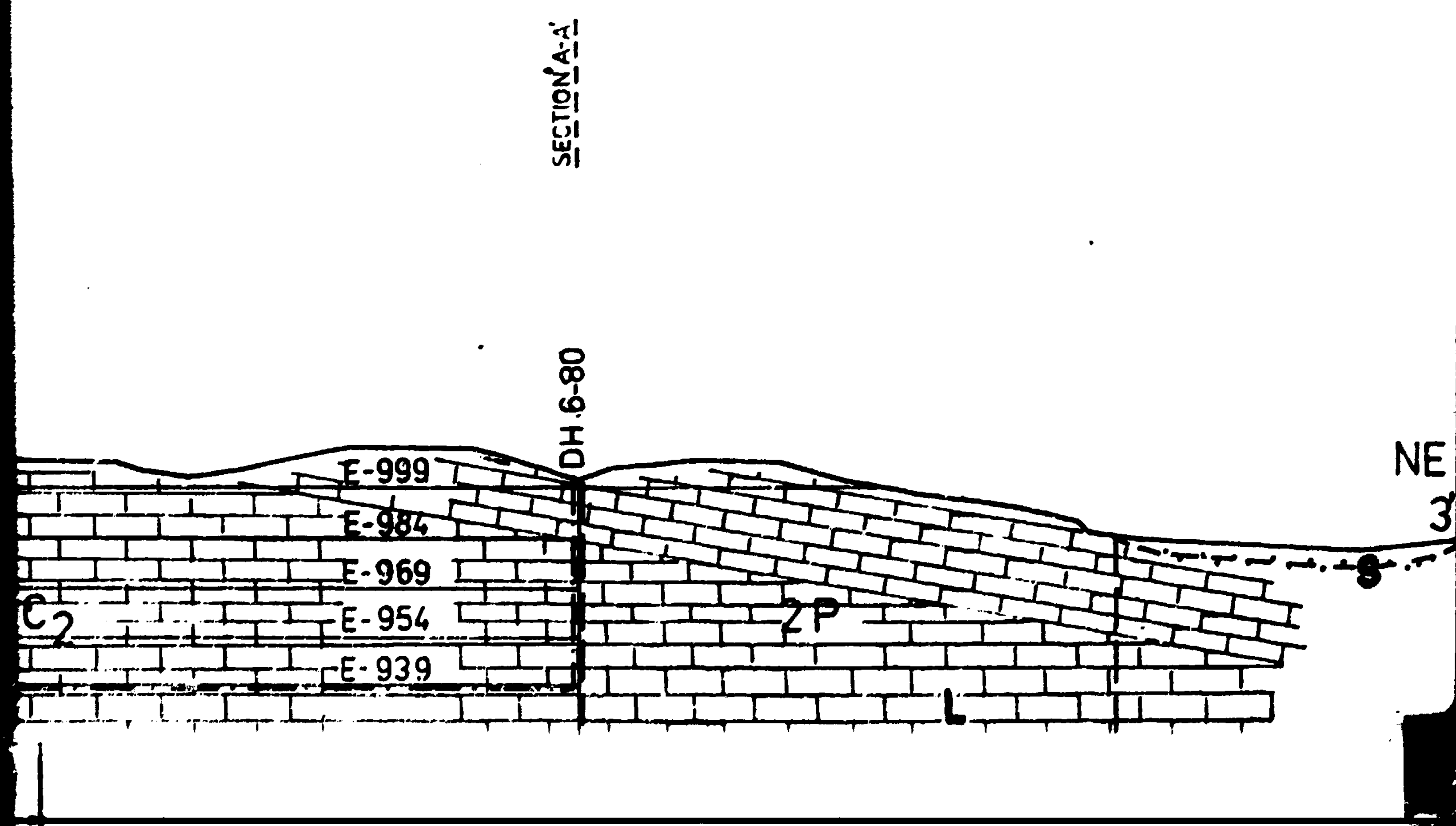
SECTION 3-3'

SCALE 1:2000

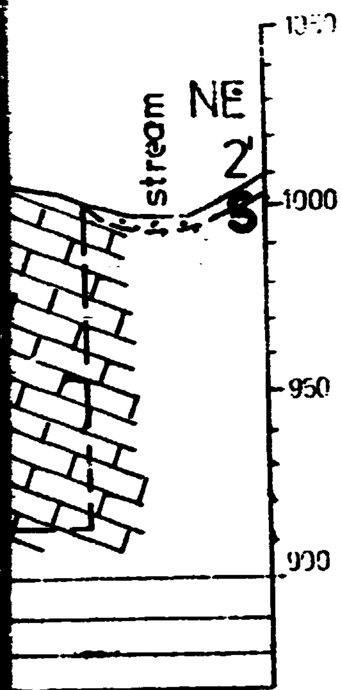


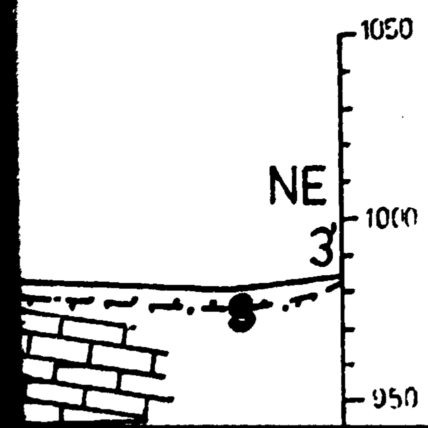
SECTION 6


SECTION B-B'
SECTION A-A'
DH-4-80
BL
E-1014
E-999
E-984
E-969
E-954
E-939
E 914 A.S.L
C2
P
2P
stream
NE
2'
1040.0
338.0
217.0
1000
950
900


SECTION A-A'
DH.6-80
E-999
E-984
E-969
E-954
E-939
C2
2P
L
NE
3'

SECTION 7





- BL — BRECCIATED
- L — LIMESTONE
- S — SOIL TERRA R
- D — DOLOMITE,DOL
- RESERVES SUG

U
D

GEOLOGICAL REPOR

BL BRECCIATED LIMESTONE

L LIMESTONE

S SOIL TERRA ROSSA

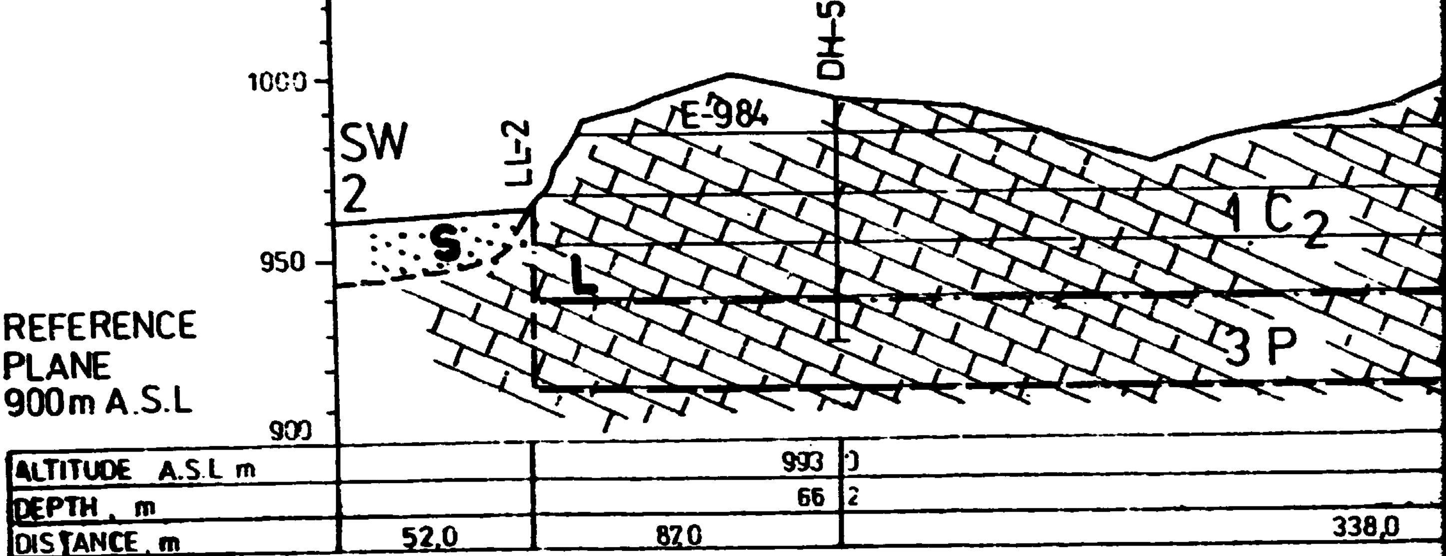
D DOLOMITE, DOLOMITIC LIMESTONE

RESERVES SUGGESTED FOR EXTRACTION

SECTION 8

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GEOLOGICAL REPORT FOR THE FEASIBILITY STUDY FOR



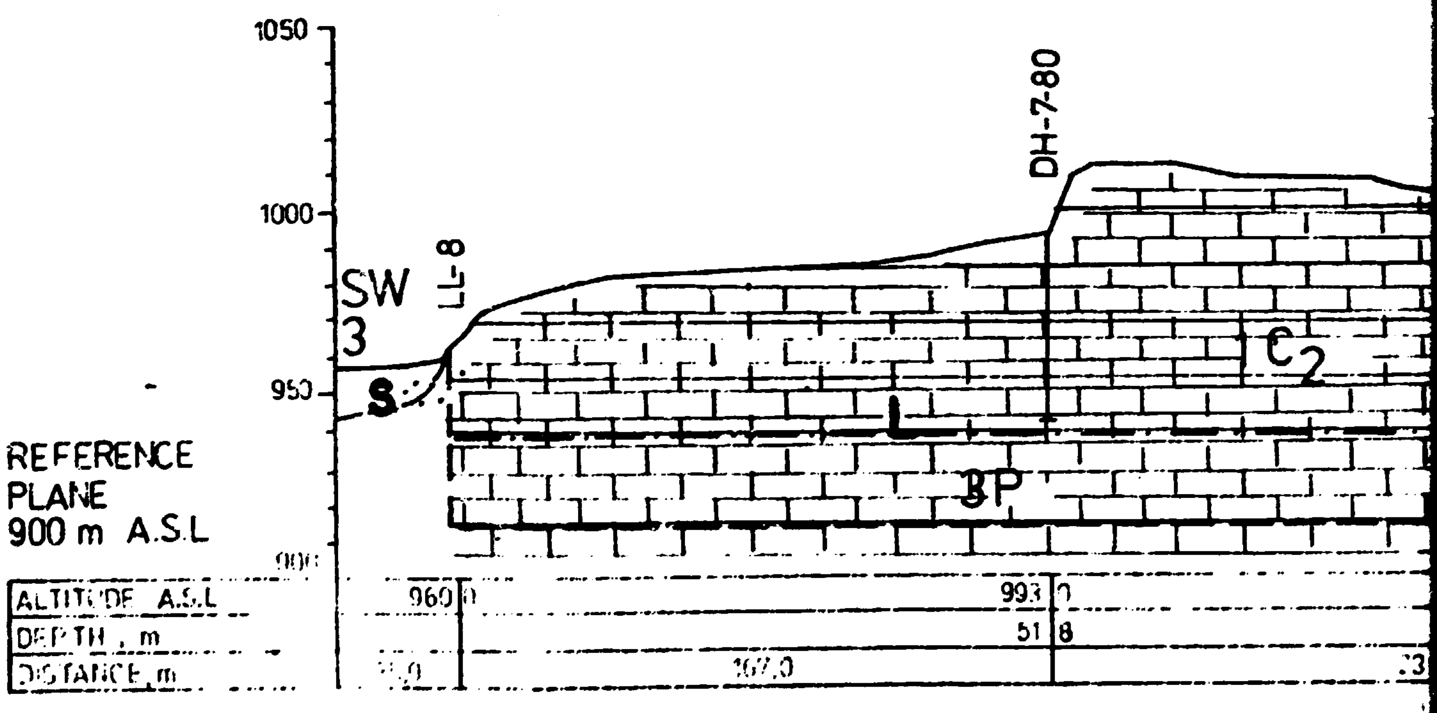
SECTION 3-3'

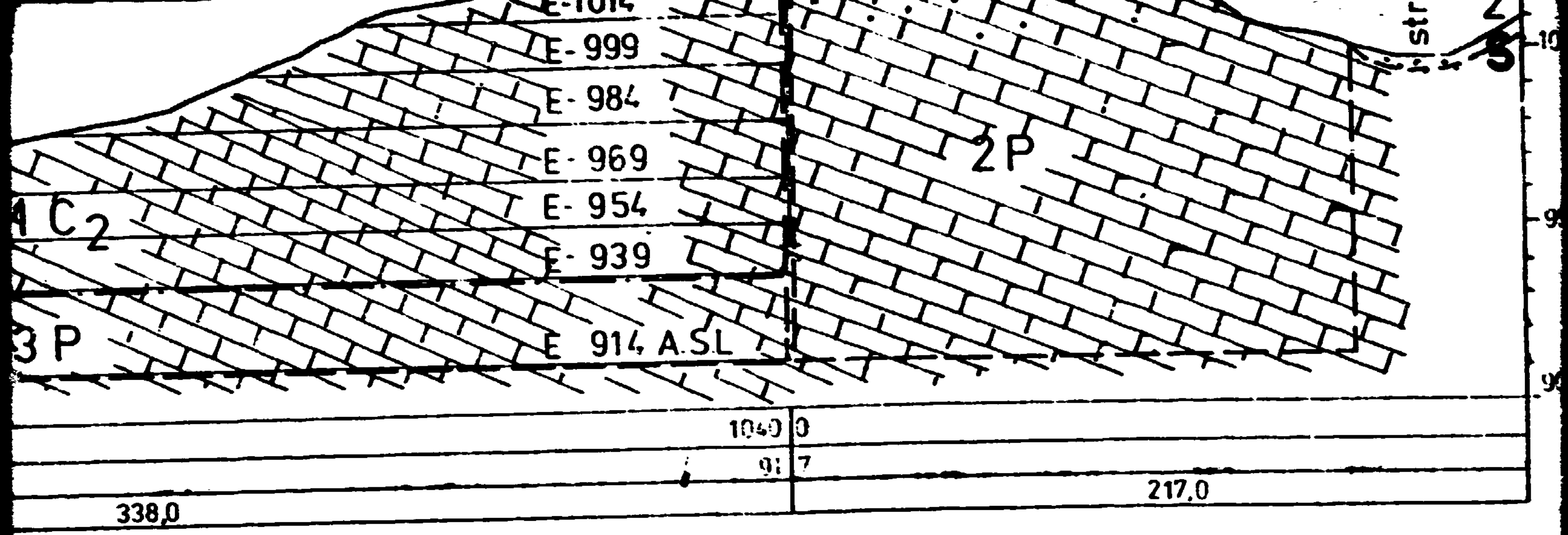
SCALE 1:2000

SECTION C-C'

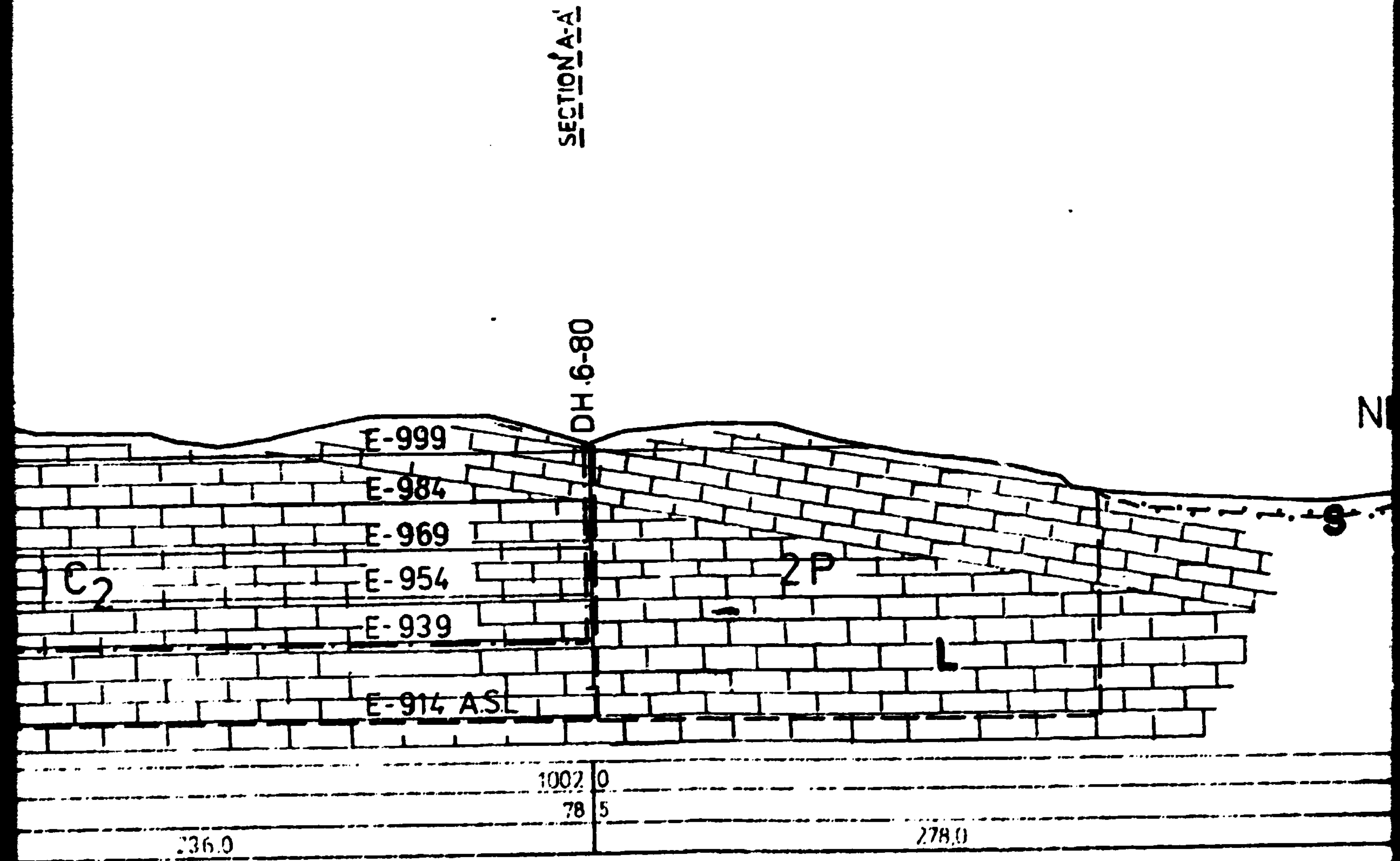
SECTION B-B'

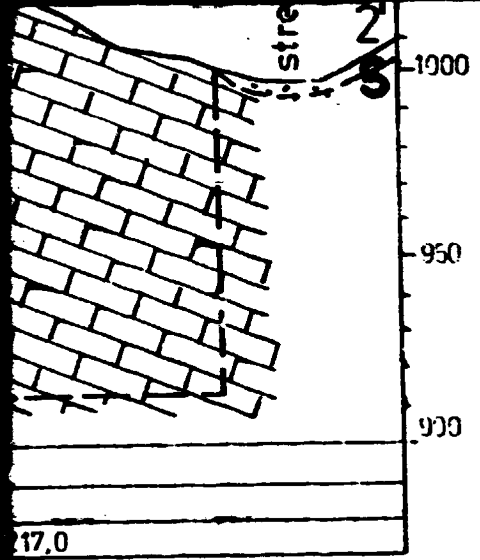
SECTION 9



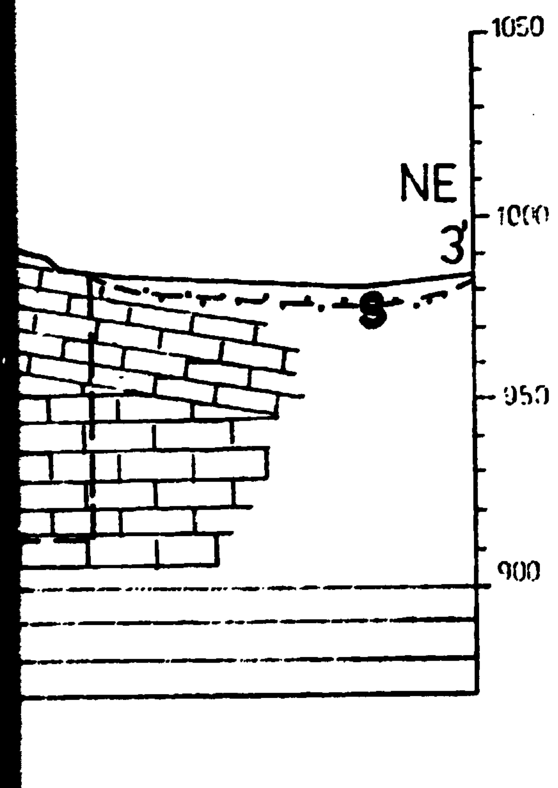

E-999
E-984
E-969
E-954
E-939
E 914 A.SL
C2
2P
3P
217.0
338.0

SECTION 10


SECTION A-A'
DH.6-80
E-999
E-984
E-969
E-954
E-939
E-914 A.SL
C2
2P
L
1002.0
78.5
278.0



SECTION 11



GEOLOGICAL I

A 200 T/D CEMEN

FEASIBILITY STUDY

PROJECT No DP/BUR

THE SOC.REP. OF THE U

POLYTECHNA PRA

KERAMOPROJEKT T

GEOLOGICKÝ PRIES

SPIŠSKÁ NOVÁ VE

CZECHOSLOVAKIA

SECTION 12

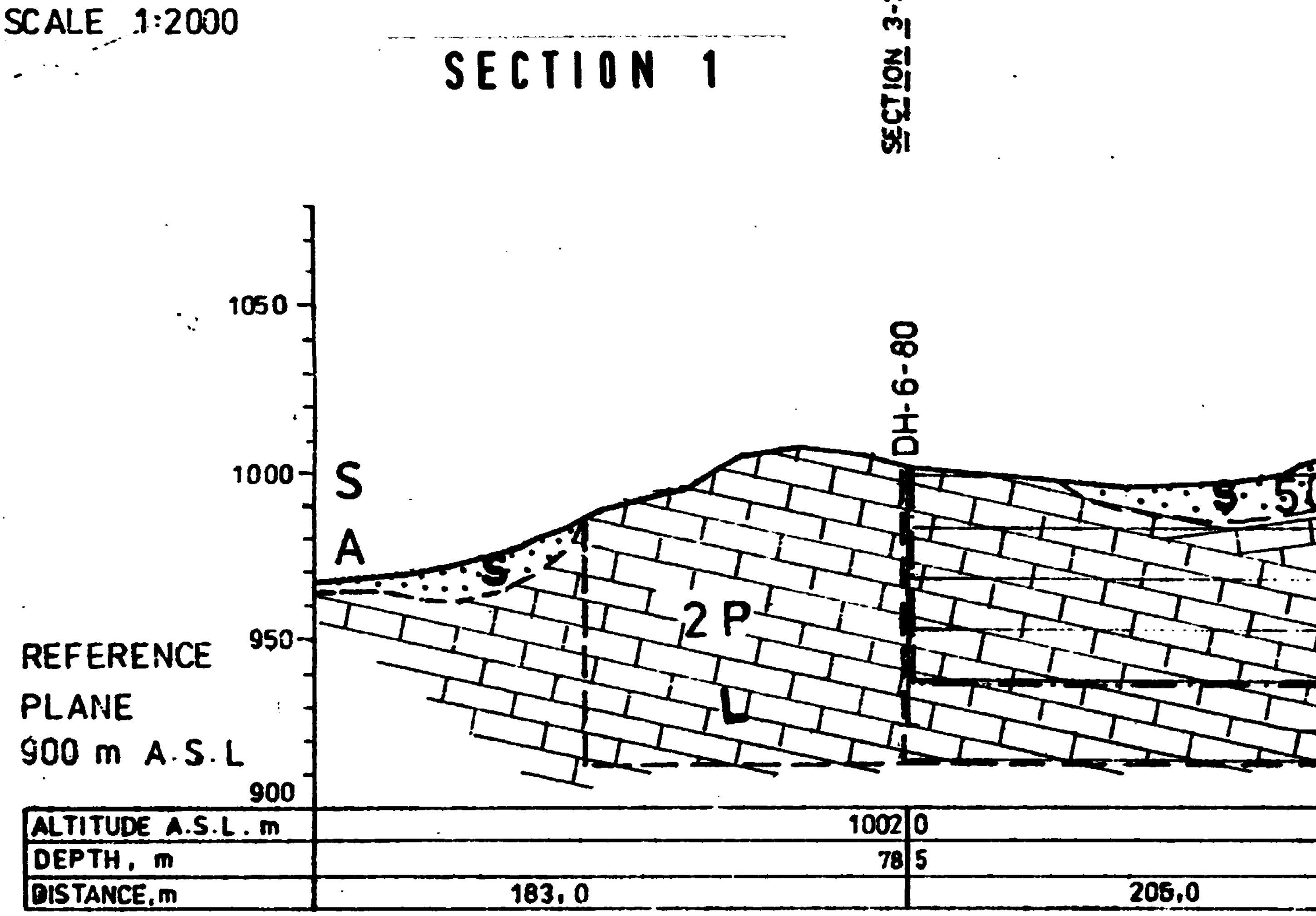
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GEOLOGICAL REPORT FOR THE FEASIBILITY STUDY FOR A 200 T/D CEMENT PLANT AT LASHIO, SHAN STATE, BURMA

FEASIBILITY STUDY	DATA JANUARY, 1988	MAP: No: 3
PROJECT No DP/BUR/80/015	SCALE: 1:2000	
THE SOC.REP. OF THE UNION OF BURMA	AUTOR S. Mikoláš	
POLYTECHNA PRAGUE		
KERAMOPROJEKT TRENČÍN	DESIGNER S. Hladká	
GEOLOGICKÝ PRIESKUM	GEOLOGICAL SECTION 1-1', 2-2', 3-3' MEHAN DEPOSIT, LASHIO TOWNSHIP	
SPIŠSKÁ NOVÁ VES		
CZECHOSLOVAKIA		

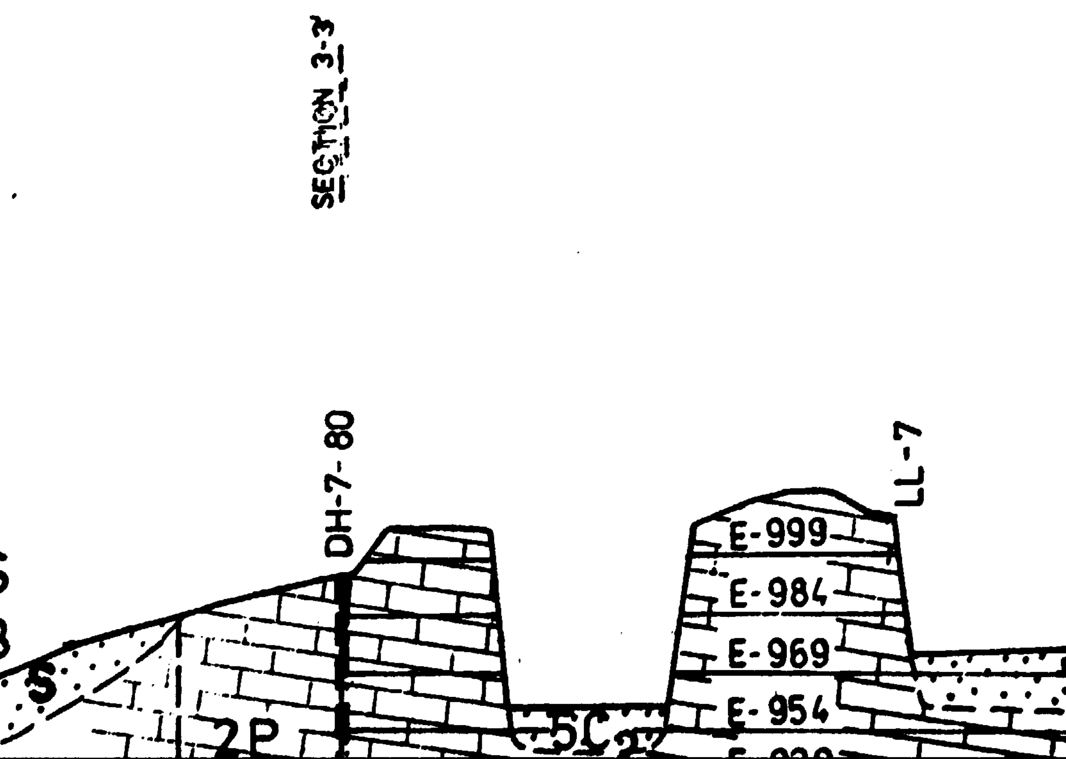
SECTION A-A'

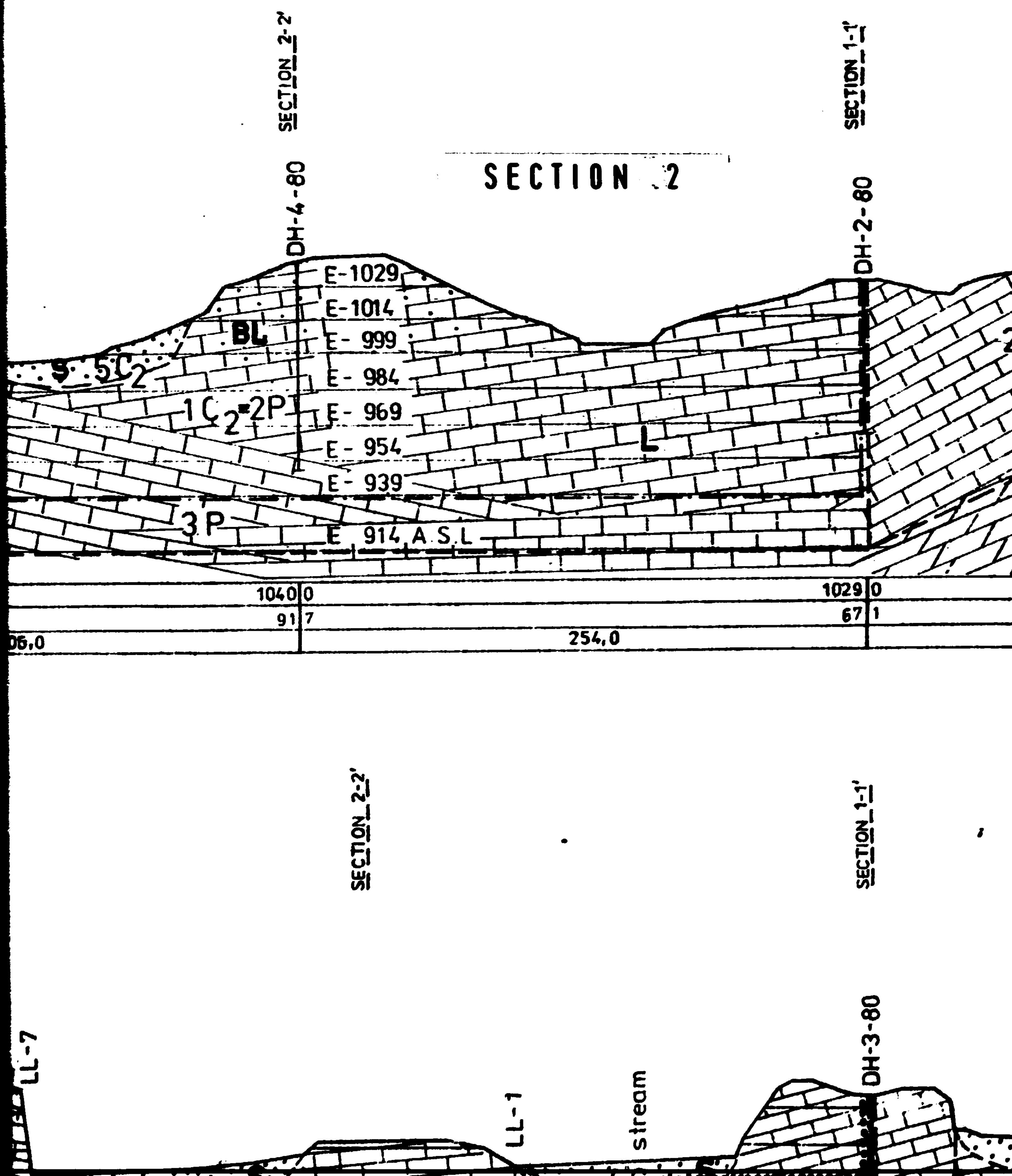
SCALE 1:2000



SECTION B-B'

SCALE 1 2000

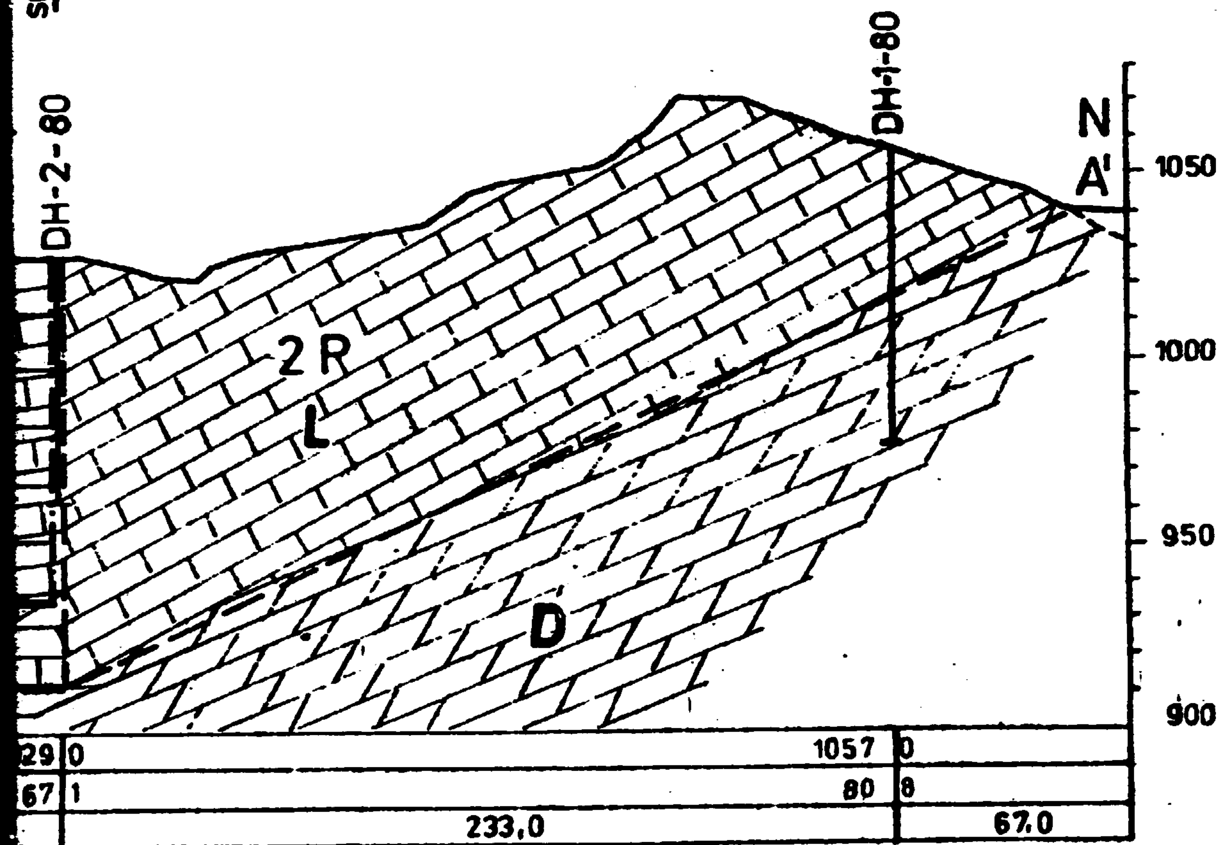




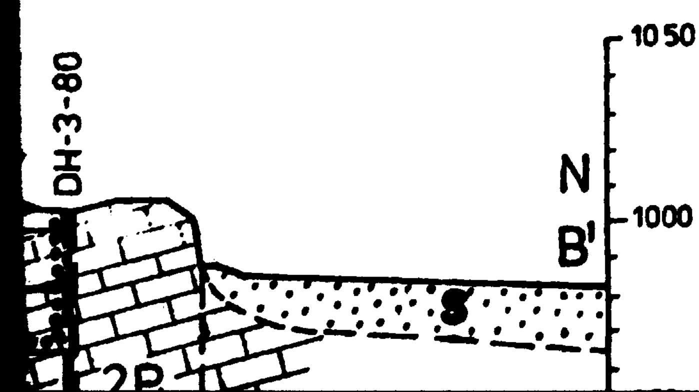
SECTION 2-2'
SECTION 1-1'
SECTION 2
DH-4-80
DH-2-80
E-1029
E-1014
E- 999
E- 984
E- 969
E- 954
E- 939
E 914 A.S.L
BL
S
5C2
1C2=2P
L
3P
1040 0
91 7
1029 0
67 1
06,0
254,0
SECTION 2-2'
SECTION 1-1'
DH-3-80
LL-7
LL-1
stream

SECTION 1-1'

SECTION 3



SECTION 1-1'



EXPLANATIONS

SECTION 4

DH-4-80	BORE HOLE
LL-1	SAMPLE
A - A'	GEOLOGICAL SECTION
E-914	BENCH-ALTITUDE ABOVE THE SEA LEVEL
$1C_2/2P$	RESERVES/RESOURCES

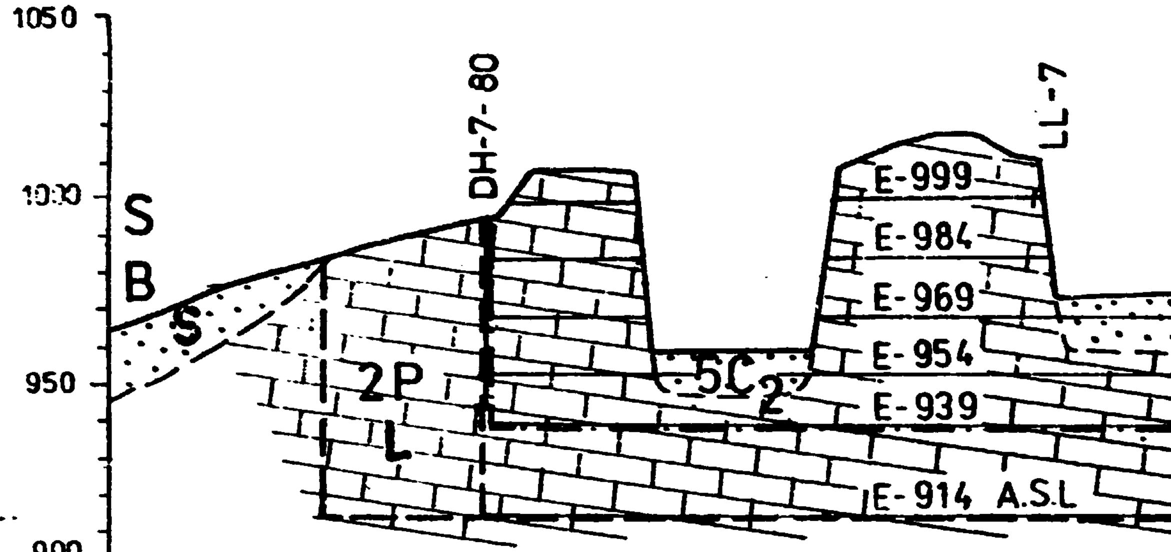
BRECCIATED LIMESTONE

LIMESTONE

SOIL TERRA ROSSA

DOLOMITE,DOLOMITIC LIMESTONE

RESERVES SUGGESTED FOR EXTRACTION



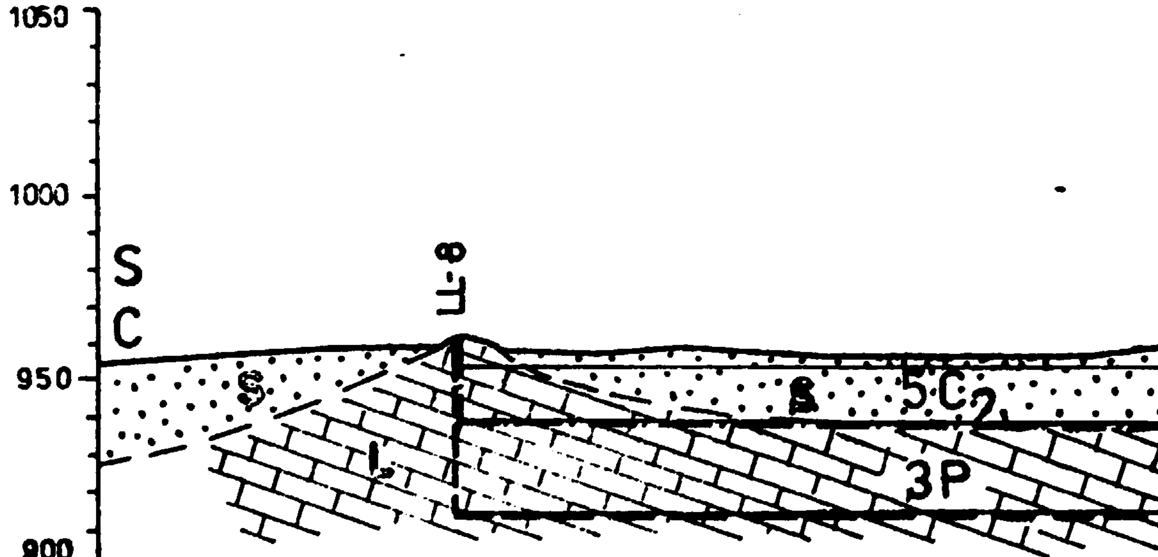
ALTITUDE A.S.L. m	993	0 973	0
DEPTH, m	51	8	
DISTANCE, m	103.0	160.0	

SECTION C-C'

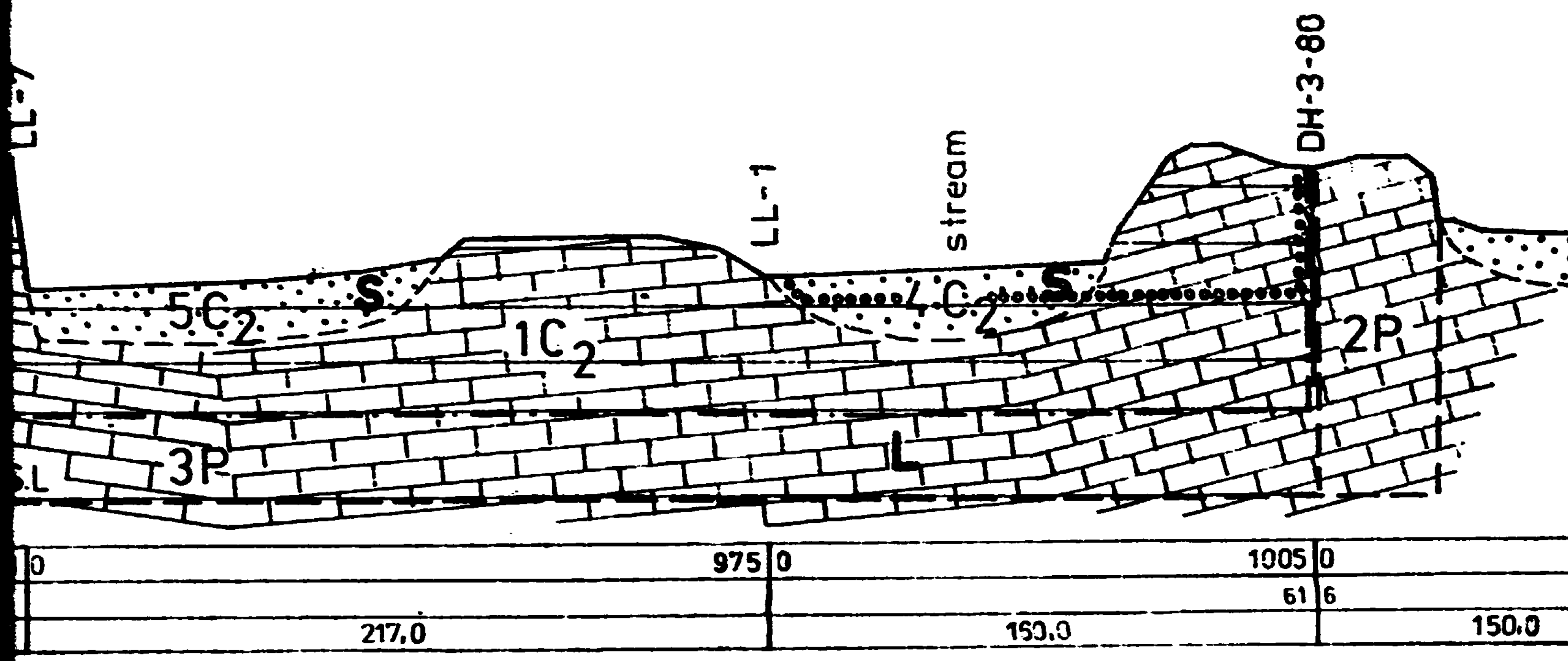
SCALE 1:2000

SECTION 3-3'

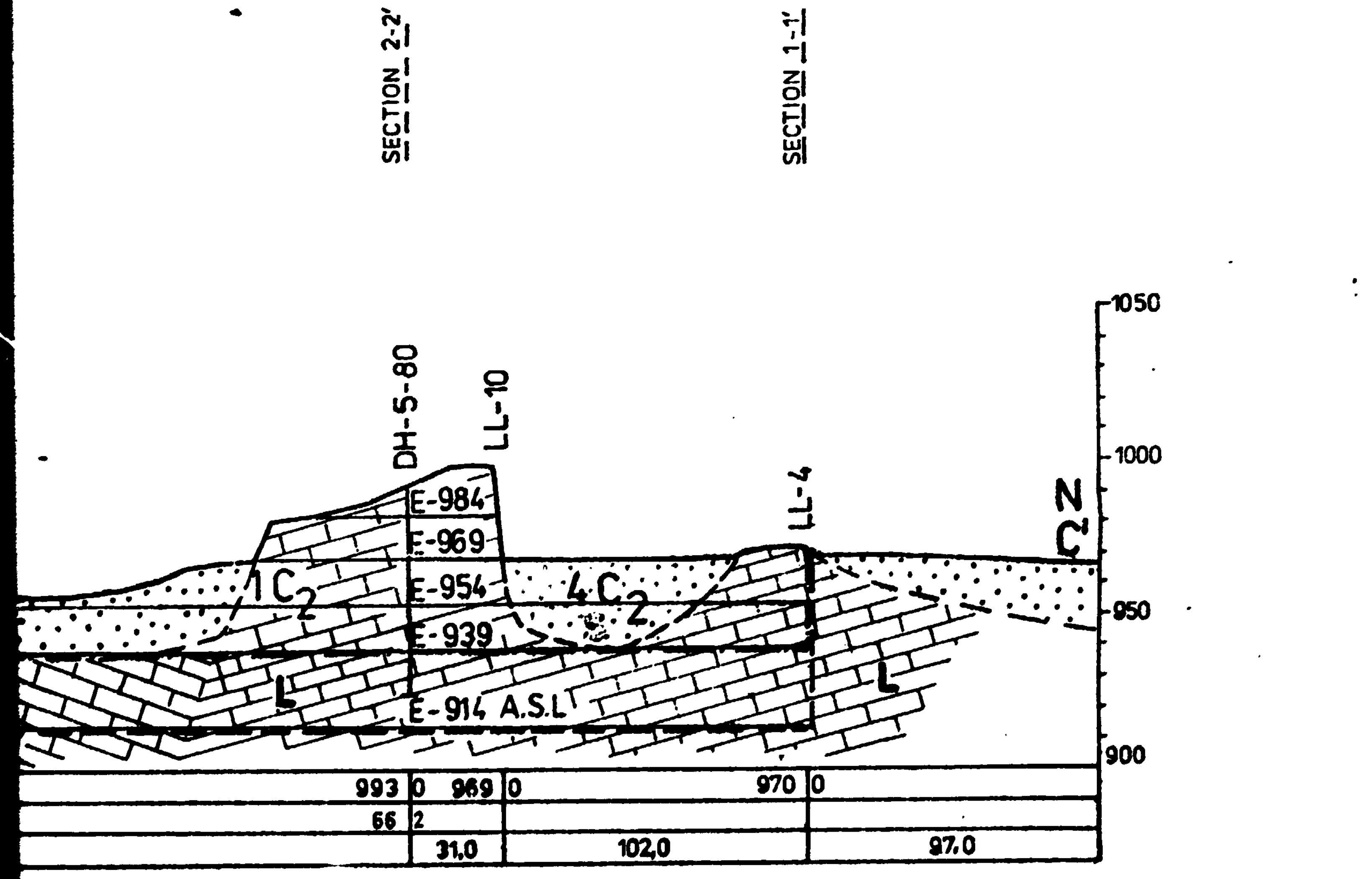
SECTION 5

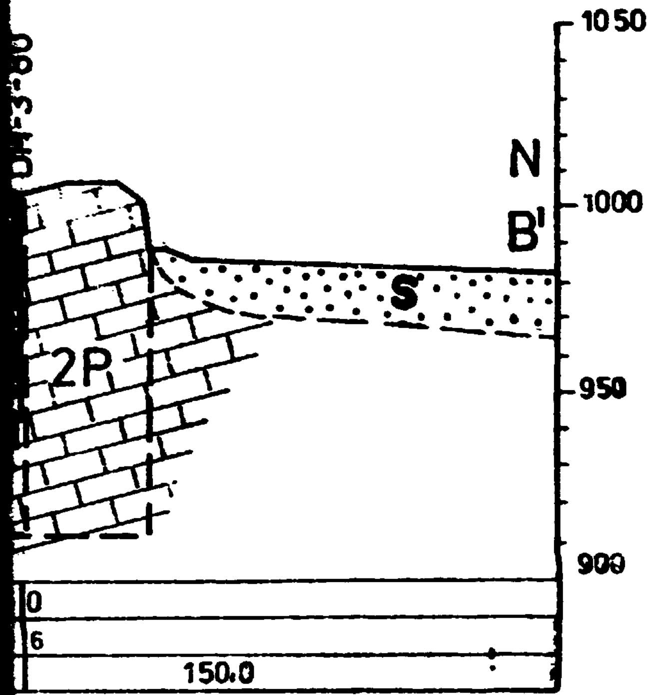


ALTITUDE A.S.L. m	960	C
DEPTH, m		
DISTANCE, m	100.0	294.0


LL-
LL-1
stream
DH-3-80
5C2
S
1C2
4C2
S
2P
3P
L
.L
0
975
0
1005
0
61
6
217.0
160.0
150.0

SECTION 6


SECTION 2-2'
SECTION 1-1'
DH-5-80
LL-10
LL-4
N
E-984
E-969
E-954
E-939
E-914 A.S.L
1C2
4C2
L
L
1050
1000
950
900
993
0
969
0
970
0
66
2
31.0
102.0
97.0



SECTION 7

SECTION 8

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GEOLOGICAL REPORT FOR THE FEASIBILITY STUDY FOR A 200 T/D CEMENT PLANT AT LASHIO, SHAN STATE, BURMA		
FEASIBILITY STUDY	DATA: JANUARY, 1988	MAP:
PROJECT No DP/BUR/80/015	SCALE: 1:2000	No: 4
THE SOC. REP. OF THE UNION OF BURMA		
POLYTECHNA PRAGUE	AUTOR: S. Mikoláš	
KERAMOPROJEKT TRENČÍN	DESIGNER: A. Jesenská	
GEOLOGICKÝ PRIESKUM	GEOLOGICAL SECTION	
SPIŠSKÁ NOVÁ VES	A-A', B-B', C-C' MEHAN	
CZECHOSLOVAKIA	DEPOSIT, LASHIO TOWNSHIP	