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1987/35. Silica deposits in the Hastings Caves - Lune River area.

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Abstract

Ordovician-aged orthoquartzite and secondary silica after dolomite in the Hastings area were examined as a potential supply of silica for industrial purposes. Neither the quality nor quantity of the materials are adequate for use in the manufacture of silicon metal or ferrosilicon. Some of the material is used in road construction.

INTRODUCTION

A scout hammer-drilling programme was conducted by the Department of Mines in September 1986 to investigate a potential silica resource. If the results had been encouraging this programme was to be followed by a diamond-drilling programme to obtain more meaningful samples for analysis and physical tests.

LOCATION

Hastings Caves is situated 90 km (by road) south-west of Hobart. Drill sites were located on Hastings Caves Road, Creekton Road, North Lune Road and South Lune Road. Details of drilling and analyses are given in Appendix 1.

PREVIOUS WORK

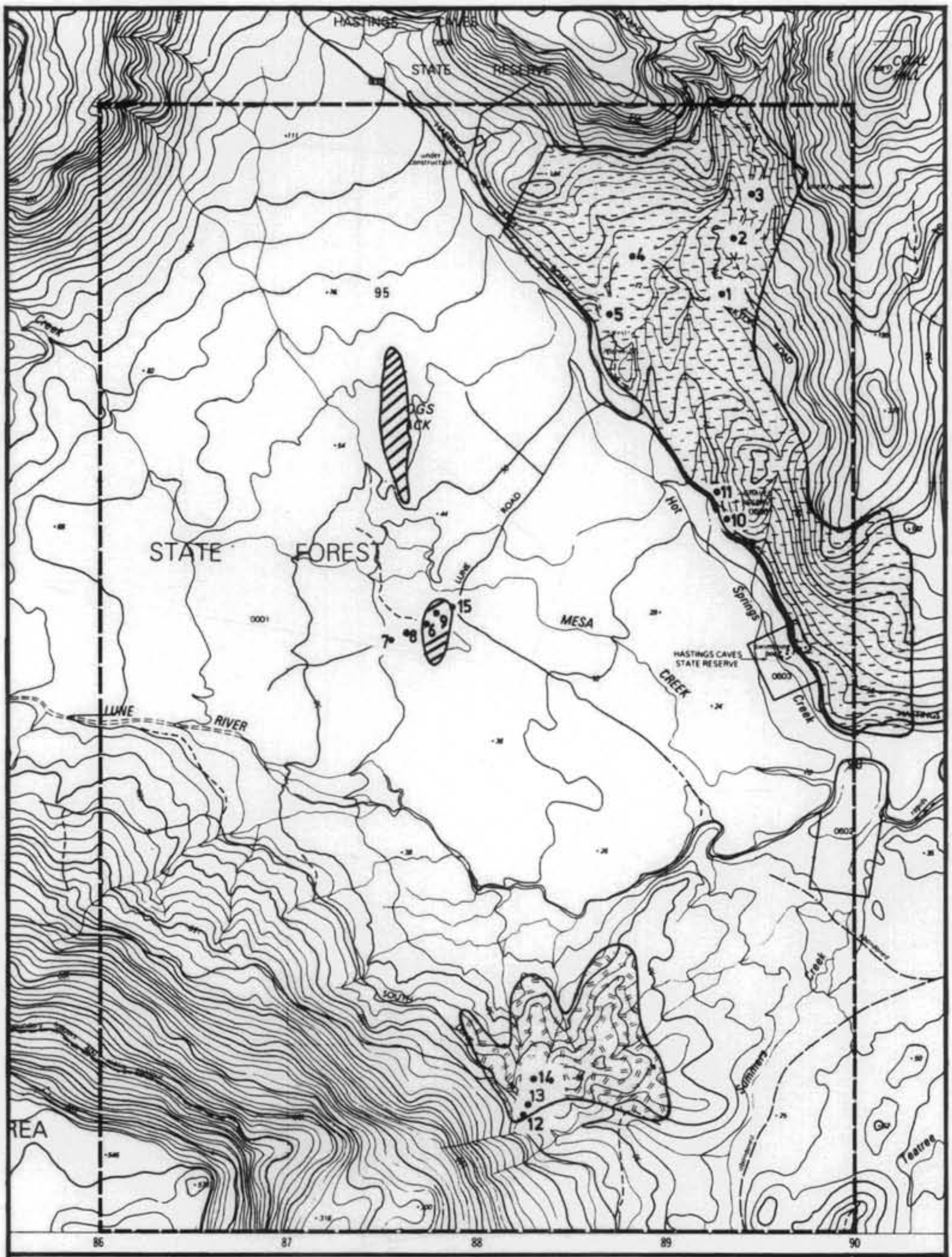
Hughes (1959) considered the silica deposits on Hastings Caves Road and the Hogs Back to be quartzite of Precambrian age. Grab samples from both deposits assayed at 99.2% SiO_2.

Sharples (1979) assigned an Ordovician age to the Hogs Back quartzite and considered the deposit on Hastings Cave Road to be a lag deposit derived by replacement of Precambrian dolomite. The two deposits were therefore considered to be unrelated. The holes on Creekton Road were drilled into material similar to the Caves Road deposit, which forms a thin veneer over dolomite.

Consolidated Goldfields drilled a borehole into the Hogs Back deposit in 1974 and a log of this hole is given in Summons (1981). The assay results from this borehole do not confirm Hughes predictions, which were based on surface samples, and it is apparent that surface enrichment due to leaching of impurities has occurred.

The orthoquartzite at depth contained pyrite and had a lower silica content than at the surface. The Al_2O_3 content in samples from this drilling was surprisingly low and needs confirmation.

Summons (1981) estimated a reserve of four million tonnes in the Hogs Back silica deposit but as only one borehole had been drilled this figure has only 'possible reserve' status.



SILICA DEPOSITS

LUNE RIVER - HASTINGS AREA

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0 1 2km

- Exempt Area SR 1983/63
- •14 Borehole location
- Secondary silica, alluvial sandy gravel
- Secondary silica, derived from veins in Precambrian dolomite
- Ordovician orthoquartzite

Geology after Sharples (1979)

Figure 1.

5 cm

QUALITY REQUIREMENTS

Two potential users of a suitable silica source are the silicon plant at Electrona and TEMCO at Bell Bay.

The local market for silica is for silicon production at Electrona, but a very pure product is required. At Bell Bay, which is 350 km north of Hastings, there is a market for ferro-silicon and silico-manganese manufacture. The chemical requirements are:

	Silicon	Ferro-silicon	*Silico-manganese
SiO_2	99	98	95-98
Al_2O_3	<0.15	<0.5	<0.8
Fe_2O_3	<0.2	<1.0	<1.0
TiO_2	<0.003	<0.02	<0.02
CaO	<0.01	<0.1	<0.1
P_2O_5	<0.01	<0.1	<0.1

*There is no current demand for material of this quality because local supplies are obtainable from Beaconsfield. The ferro-silicon quality material is presently being imported from Whyalla and a local source is therefore being sought.

In addition to the chemical specification, the material must comply with grain size, strength and fusion point requirements.

THE DRILLING PROGRAMME

Hastings Caves Road

Seven holes were drilled into the secondary silica deposit to depths of 7.5, 4.0, 2.0, 3.0, 2.5, 6.0 and 8.0 metres but due to caving of the holes or high water tables, it was only possible to obtain representative samples from three of the holes. The Al_2O_3 content in these three holes was:

DDH	Depth	Al_2O_3 (%)
1	7.5	0.65
2	2.0	0.19
3	1.3	0.51

The gravel pits on Hastings Caves Road were sampled by Hughes (1959) and high purity silica was recorded. Such results may only be representative of leached surface material. It is predicted, therefore, that only the upper two metres of this deposit is of acceptable purity.

If half of this 28 km^2 area contained a two metre thickness of usable silica which was 50% recoverable, the resource could amount to two million tonnes at most.

The resource is small and of marginal quality. Mining the material would destroy 2 km^2 of natural forest, and the deposit is situated in a popular tourist area. It is doubtful, therefore, that this deposit has any economic importance at present.

North Lune Road

An elongate outcrop of quartzite crosses this road in apparent strike continuity with the Hogs Back outcrop. The actual width of the outcrop on North Lune Road is about five metres, much less than the 160 m indicated on Sharples (1979) map, which shows the quartzite covering an area of 3.5 ha. Of five holes drilled across this indicated occurrence, only one (Hole 6) was actually drilled in the quartzite.

This hole reached a depth of 29.5 m which was the limit of the hammer drill compressor. The mean silica content was 95% and the mean Al_2O_3 content was 0.65% - this quality approaches the requirements for ferro-silicon and it was disappointing that the other holes drilled nearby (Holes 7, 8, 9 and 15) did not intersect this material.

The outcrop has an easterly dip of 50! and it was anticipated that the material would have been intersected in at least Holes 9 or 15, but caving of the hole and a high water table prevented effective penetration. A pump test was carried out on this hole and the results have been reported by Matthews (1989).

The geological structure here is not known. The Hogs Back and North Lune Road outcrops may be faulted inliers, in which case their lateral extent would be minimal. These isolated outcrops on the alluvial plain of the Lune River would probably be difficult to mine below ground level because of the extremely wet conditions and the likelihood of huge boulders in the alluvium, judging from the prevalence of such on the surface in this area.

South Lune Road

An area mapped as quartzite by Sharples (1979) was also examined during this programme. Conditions at this time were so wet that the only access was in the vicinity of a Forestry Commission gravel pit. Two holes were drilled to depths of 24 m (DDH13) and 38.5 m (DDH14) in siliceous sediments. Only one of these holes (DDH14) was sampled, with an average of 92.3% SiO^2 and 2.45% MgO over the 38.5 m drilled. Rock chips obtained from the base of the hole are probably limestone (tested by acid and XRD analyses). Shell fragments were found in these chips (M. J. Clarke, pers. comm.) indicating that the chips were of Ordovician-aged limestone.

The material recovered from drilling was in the form of a fine powder, with few rock chips. Hammer drilling is not really suited for use in such wet conditions, or where the grain size distribution and rock friability are characteristics which one wishes to examine in the drilled samples. This material, being soft and friable and in an unconsolidated form, is unlikely to provide a satisfactory furnace feed even if chemically pure enough. However the substance is also chemically unacceptable for metallurgical purposes.

The area drilled and nearby ridges seem to be composed of 'drift' (i.e. unconsolidated material), ranging in size from sand to cobbles. This is quite unlike the hard orthoquartzite cropping out on the Hogs Back and on North Lune Road. The material is most likely a Recent alluvial deposit which overlies the limestone, unlike the orthoquartzite which underlies the limestone.

CONCLUSION

Neither the Ordovician orthoquartzite outcrop on the North Lune Road, the Recent alluvial gravel on South Lune Road, nor the replacement silica deposits adjacent to the Hastings Caves Road warrant further investigation as a source of metallurgical silica. The quality of each deposit is too poor to be of any industrial use, although the replacement silica in the Hastings Caves Road area and the sandy gravel in the South Lune Road area are currently utilised by the Forestry Commission as a surface course on logging roads.

If the resource was closer to markets it is possible that these two deposits could be upgraded to produce glass-sand quality material by washing and screening, but the main use is likely to remain as a road material.

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[26 August 1987]

APPENDIX 1

Details of drill holes and samples

BH No	Locality	AMG ref.	Depth (m) From	Depth (m) To	Thick. (m)	Sample No.	Lab Ser No.	Analysis SiO_2	Analysis CaO	Analysis MgO	Analysis Al_2O_3	Depth water struck (m)	Log
1	Creekton Road (FC gravel pit)	DM893950	0	2	2	1.1	862424	97.0	0.30	0.11	0.88		Fine white sand
			2	4	2	1.2	862425	97.5	0.22	0.10	0.38		
			4	5	1							4.5	Humic staining below watertable. Hard drilling from 5 to 7.5 m in white-grey chert? with dark brown sandy matrix
			5	6	1								
			6	7.5	1.5	1.3	862426	97.1	0.22	0.09	0.71		
							mean	95.0		mean	0.65		
2	Creekton Road (FC gravel pit)	DM894953	0	2	2	2.1	862427	97.9	0.02	<0.01	0.19		Fine white sand
			2	2.5	0.5								Dirty grey sand
			2.5	4	1.5	2.2	862428	68.0	0.25	0.29	12.4		Orange clay
													Hole caved
3	Creekton Road (FC gravel pit)	DM895955	0	1.3	1.3	3.1	862429	96.9	0.10	0.05	0.51		Dirty grey sand
			1.3	2.0	0.7								Orange clay
4	Creekton Road (FC gravel pit)	DM888952	0	3	3	4.1	862430	78.6	0.03	0.62	11.1		Fine sand (2 m) and grey clay (1 m)
						(sample contaminated by underlying clay)							
5	Creekton Road (FC gravel pit)	DM887949	0	0.7	0.7	Samples were too contaminated for analysis							Off-white hard silica (chert?)
			0.7	1.8									Hard white silica
			1.8	2.5									Brown sand
6	North Lune Road (quartzite outcrop)	DM878933	0	0.8	0.8)	6.1	862431	96.7	0.04	<0.01	0.57		White quartzite
			0.8	2.0	1.2)								Brown mud mixed with quartzite chips
			2	2.2	0.2	6.2	862432	97.4	0.04	<0.01	0.51	2	Grey and white quartzite
			2.2	4.0	1.8	6.3	862433	96.7	0.03	0.01	0.63		As above with green flecks
													Green and white quartzite
			4.0	6.0	2	6.4	862434	97.0	0.01	0.03	0.70		As above
			6	8	2	6.5	862435	95.4	<0.01	0.15	1.04		As above
			8	10	2	6.6	862436	92.9	0.01	<0.01	0.40		As above
			10	12	2	6.7	862437	87.1	<0.01	<0.01	0.51		As above with dissemin. pyrite
			12	14	2	6.8	862438	96.6	<0.01	0.01	0.95	1.25 l/s (est.)	Green quartzite
			14	16	2	6.9	862439	91.8	0.01	0.02	0.68		Green and brown quartzite
			16	18	2	6.10	862440	96.2	0.07	0.01	0.61		As above
			18	20	2	6.11	862441	94.5	0.05	<0.01	0.74		Grey and white and brown quartzite
			20	22	2	6.12	862442	96.3	0.09	<0.01	0.90		As above
			22	24	2	6.13	862443	95.9	0.01	<0.01	0.89		
			24	26	2	6.14				mean	0.73		
			26	28	2	6.15							
			28	29.5	1.50	6.16							
7	North Lune Road	DM876932	0	2	2	-		Hole not sampled due to caving					Boulders of dolerite and quartzite at surface. samples very wet, clayey, and humic stained.
			2	4	2	-							
			4	6	2	-							
8	North Lune Road	DM87709325	0	2	2								As above
			2	4	2	-							
			4	6	2	-							
9	North Lune Road	DM87859335	0	2	2	-							As above
			2	3	1	-							

BH No	Locality	AMG ref.	Depth (m) From	Depth (m) To	Thick. (m)	Sample No.	Lab Ser No.	Analysis SiO_2	Analysis CaO	Analysis MgO	Analysis Al_2O_3	Depth water struck (m)	Log
10	Hastings Caves Road (gravel pit)	DM893938	0	2		-	Hole not sampled due to water					At surface	Fine white sand changing to grey at 0.5 m
			2	4		-							
			4	6		-							
			6	8		-							
11	Hastings Caves Road (gravel pit)	DM893939	0	2		-	Hole not sampled due to water					At surface	As above
			2	4		-							
			4	6		-							
12	South Lune Road (gravel pit)	DM88259065	0	2		12.1	862444	98.1	0.01	<0.01	0.25		Crumbly, yellow sandstone
			2	4		12.2	862445	97.9	0.01	<0.01	0.31		
			4	6		12.3	862446	98.2	<0.01	<0.01	0.36		
										mean	0.31		
13	South Lune Road (east of gravel pit)	DM88309065	0	2	2								Fine white sand with varying clay content and degrees of staining
			2	4	2								
			4	6	2								
			6	8	2								
			8	10	2								No samples submitted (labelling of bags illegible)
			10	12	2								
			12	14	2								
			14	16	2								
			16	18	2								
			18	20	2								
			20	22	2								
			22	24	2								
14	South Lune Road (NE of gravel pit)	DM883908	0	2.5	2.5	14.1	862448	94.1	0.02	<0.01	0.53		Fine, humic-stained sand and rock chips
			2.5	5.0	2.5								
			5.0	7.5	2.5	14.2	862449	88.7	0.02	0.15	3.23		
			7.5	10.0	2.5								
			10.0	12.5	2.5	14.3	862450	94.5	0.01	0.05	1.63		
			12.5	15.0	2.5								
			15.0	17.5	2.5	14.4	862451	95.3	<0.01	<0.01	1.16		
			17.5	20.0	2.5	14.5	862452	94.7	0.01	<0.01	1.57		
			20.0	22.5	2.5	14.6	862453	94.6	0.04	<0.01	1.80		
			22.5	26.0	3.5	14.7	862454	93.9	0.03	0.09	2.31		
			26.0	28.5	2.5	14.8	862455	87.4	0.11	0.30	5.66		
			28.5	31.0	2.5	14.9	862456	94.4	0.04	0.25	1.97		
			31.0	33.5	2.5	14.10	862457	93.7	0.05	0.07	1.99		
			33.5	36.0	2.5	14.11	862458	86.3	0.20	0.29	4.97		
			36.0	33.5	2.5	14.12	862459	78.6	6.69	0.21	2.68		
							mean	91.3			2.46		
15	North Lune Road	DM87909335	0	6			862460	94.9	0.03	<0.01	1.02		Dolerite and quartzite boulders at surface

APPENDIX 2

Petrology of samples from the Lune River-Hastings silica deposit

R. S. Bottrill

Abstract

Three samples from a percussion drill hole through the Lune River-Hastings silica deposit were examined petrologically. The two uppermost samples were determined to be mature quartzarenites, with variable but small amounts of ferruginous clay and other impurities. The lowermost sample exhibits a range of rock types indicating silicification of dolomites and ?dolomitic sandstones below the quartzarenite.

INTRODUCTION

Three samples of rock ships from Lune River borehole 14, a percussion drill hole through the Lune River silica deposit, were received from V. M. Threader for description. Details of the samples are given below:

T.D.M. Reg. No.	*Borehole depth (m)*	*Description*
C100049	15-17.5	Brown and white silica
C100050	28.5-31	Brown and white silica
C100051	36-38.5	Silica and dolomite

All samples were examined by transmitted light microscopy.

DESCRIPTIONS

C100049

Both the brown and white rock ships proved to be well sorted, fine- to medium-grained quartzarenites. The brown silica has a ferruginous argillaceous matrix, containing very fine-grained hematite, silty quartz, kaolinite and trace sericite. Some coarse aggregates of similar material were probably derived from rock and feldspar grains. The white silica is of two different types, one with a cherty matrix (and sand-sized chert grains) and the other with little or no matrix. The latter type exhibits, in part, quartz overgrowths and sutured to orthoquartzitic textures.

Trace amounts of white mica flakes, zircon and tourmaline are present. The original quartz sand was mainly sub-rounded to rounded, from coarse silt to coarse sand in size.

C100050

This sample is very similar to the above, but rare schist grains are evident.

C100051

This sample contains brown and white silica identical to the above samples, and also dolomite and chert. There is a gradation from quartzarenite with a cherty matrix to cherts with only minor quartz sand and mica. Some chert contains relict dolomite fragments, and exhibits textures compatible with replacement of the granular dolomite. The dolomites are mainly fine to medium grained with only a trace of quartz sand, and some exhibit stylolites and patchy coarse-grained areas. Poorly sorted quartzarenite is rarely present.

DISCUSSION

The silica deposit is basically a mature quartzarenite with variable amounts of ferruginous and argillaceous impurities. Purer silica may be associated with zones of silicification.

Chert has formed at the base of the arenite, where it grades into dolomite and sandy dolomite, and other silicified arenites in the sequence may represent original carbonate-bearing horizons. Alternatively they may simply represent zones of enhanced permeability. The secondary silica was probably deposited largely by reaction of acidic groundwaters, dissolving silica from above formations and precipitating it by reaction with the alkaline dolomite below.

[1 December 1986]