CC PROSPECT, CHU CHUA MOUNTAIN
(92P/8W)

By W. J. McMillan

INTRODUCTION

Interest in the Chu Chua area initially centred on a large anomalous copper gossan outlined in 1977 by Vestor Explorations Ltd. on the south slope of Chu Chua Mountain. The gossan was subsequently interpreted to be transported and prospecting up the slope eventually located a small gossan with lower but anomalous copper values adjacent to a northerly striking massive magnetite body. In 1978 Craigmont Mines Limited optioned the property, which is jointly owned by Vestor Explorations Ltd., Pacific Cassiar Limited, and Seaforth Mines Ltd., and discovered massive sulphide mineralization. In 1978 Craigmont did 2 843 metres of BQ diamond drilling in 23 holes and announced geological reserves of approximately 2 million tonnes of 2 per cent copper, 0.4 per cent zinc, 0.4 gram per tonne gold, and 8 grams per tonne silver. In 1979 an additional 2 932.6 metres of drilling was done in 17 holes to further delineate the deposit (Fig. 10).

ACCESS

The CC property lies about 20 kilometres north-northeast of Barriere on the ridge east of Chu Chua Mountain at 1 800 metres elevation. Access is via paved and logging roads from Barriere along Barriere River, North Barriere River, and Birk Creek. The last few kilometres require a four-wheel-drive vehicle, especially in wet weather.

REGIONAL GEOLOGY

A thick pile of massive to pillowed basalts with local pods and layers of cherty tuff and greywacke comprise the lower part of the Fennell Formation in the Chu Chua area. Stratigraphically upward these give way to massive basalt, then through a transitional zone of basalt, chert, phyllite, quartz feldspar porphyry, and intraformational chert conglomerate (Preto, 1979, this report) into overlying phyllites and turbiditic sandstones of the Eagle Bay Formation. Mississippian (Osagian to Early Meramecian) megafossils and conodonts occur in limestone lenses in Eagle Bay rocks south of Barriere River (Okulitch and Cameron, 1976).

Ministry of Energy, Mines and Petroleum Resources mapping has not yet extended north to Chu Chua Mountain but the deposit lies within the Fennell Formation, apparently just below the base of the transition zone. The exact position is uncertain because although the deposit and nearby basalts have a subvertical dip and apparently face west, interbedded pillow lavas, chert, and conglomerate a kilometre to the east apparently face eastward. If the sequence is actually folded, the CC mineralized horizon could be structurally repeated a short distance east of the known mineralization (Preto, this report).

On the Bonaparte map sheet (Campbell and Tipper, 1971), Fennell Formation rocks continue northward for approximately 35 kilometres. Whether the transition zone curves around or is cut off by the Baldy batholith is not known. It reappears, however, west of Foghorn Mountain and should continue northward to Clearwater where it is cut off by the Raft batholith. Although they are all reported to be veins, there

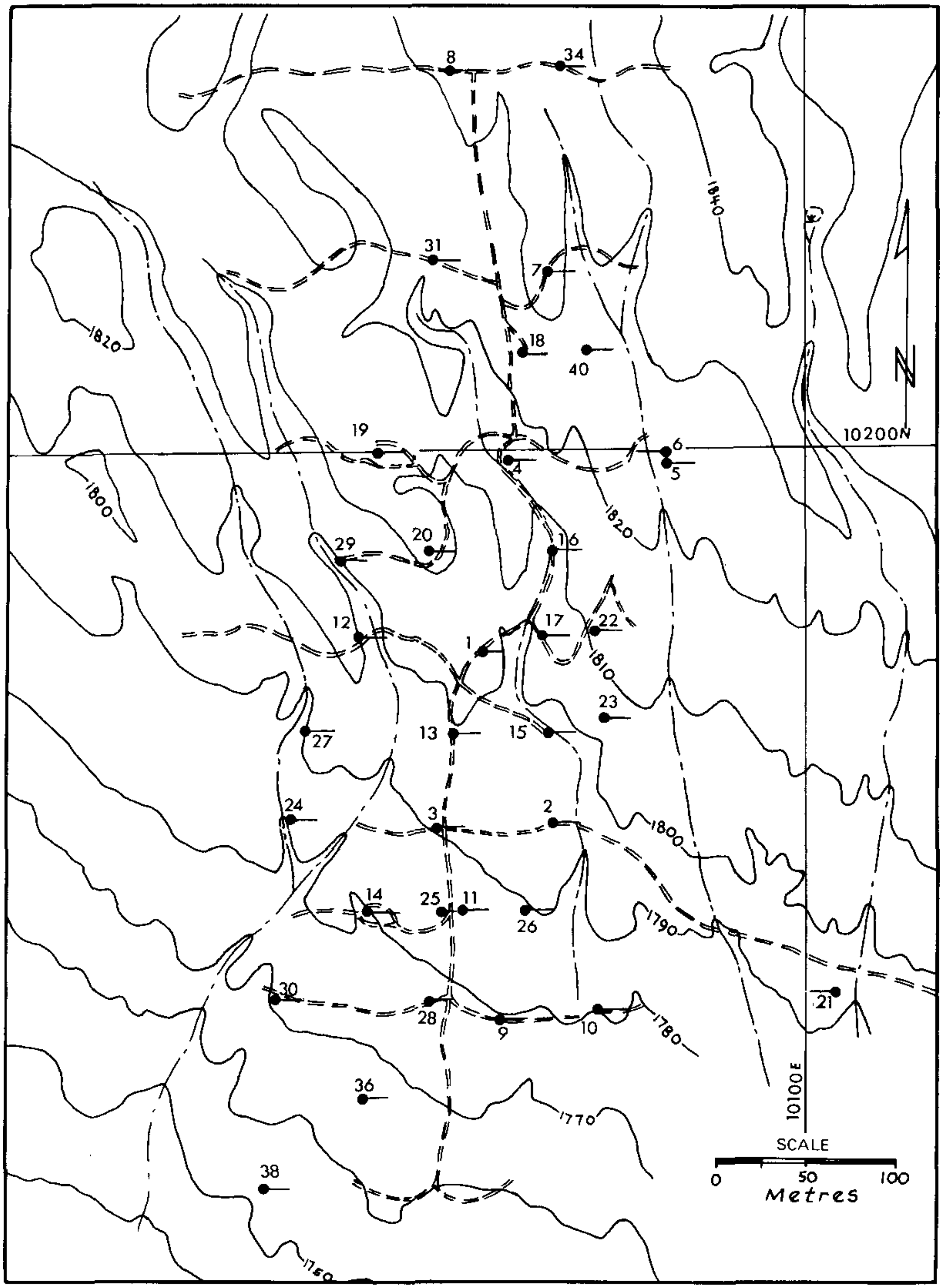

Figure 10. CC property, topography and diamond-drill hole locations (based on company maps); all drill holes are inclined.

are several lead-zinc occurrences between Chu Chua deposit and Clearwater. The area warrants investigation.

LOCAL GEOLOGY

Surface exposures at CC are not abundant and were not mapped in detail. The preliminary geological interpretations presented here are based on examination of core from diamond drilling with no laboratory backup.

Dark green to grey-green pillow basalts and basalts are the dominant country rock of the CC deposit. Although primary volcanic textures are easily recognized, Fennell Formation rocks have been regionally metamorphosed to lower greenschist facies. Primary pyroxene in the basalt has been replaced by hornblende needles and plagioclase has been saussuritized. Scattered epidote and zoisite, patches of carbonate, and some chlorite replace the matrix (Campbell and Tipper, 1971, p. 15). The effect of this regional metamorphism on the Chu Chua massive sulphides and hydrothermally altered country rock appear minimal. On the other hand, 'unaltered' country rock has been recrystallized to lower greenschist assemblages (G. White, personal communication, 1979). In areas between pillows, where minerals are most easily recognized, typical components are chalcedonic quartz, quartz, chlorite, and pyrrhotite with local epidote; other common constituents are pyrite and calcite. Interpillow zones are cut by chlorite±epidote fractures and veinlets of pyrite and calcite.

Pillows in the basalts are generally 1 to 3 metres across in drill core. Pillow rinds are chilled slightly and are chloritized or bleached. Bleaching also occurs adjacent to some of the fractures and veinlets which cut the basalt. Typical fracture fillings are chlorite with or without pyrrhotite, pyrite, or calcite; calcite (often with bleached halos); epidote-quartz with bleached halos; and epidote-calcite.

Generally, primary textures are preserved. Locally, however, alteration and dissemination of chlorite-pyrite give the rock a spotted texture. Elsewhere, where pillows are poorly developed, the rock is often finely crystalline and feldspathic. Areas of monomictic fragmental volcanic rock occur; these appear to be flow breccias.

MINERALIZED ZONES

The mineralized zone is best described as mixed chert or cherty tuff (?) and cupriferous pyrite or magnetite lenses. The cherty rocks will be described first, then the copper-bearing zones.

The cherty rocks are variably grey to pale grey-green or white, siliceous, fine-grained rocks. They are generally massive and usually closely fractured and often brecciated. Pyrite is abundant as disseminations, streaks, veins, and cement in breccia zones. In breccia zones it may be joined by a dark grey very soft mineral (talc ?). Locally the rock is finely laminated and may resemble ribbon chert. Overall, these cherty rocks appear to be chemical precipitates contaminated by volcanic debris and may be of volcanic exhalative (Ridler and Shilts, 1973) origin. In Archean deposits, similar rocks are termed cherty tuffs or tuffites.

Volcanic flows interlayered in the cherty rocks are prevasively bleached or altered to chlorite, carbonate, or talc. They resemble altered volcanic rocks along the eastern border of the cherty zone.

Locally the cherty rocks are cut by pyritic fractures and veinlets carrying chalcopyrite, carbonate-sphalerite-chalcopyrite veinlets, quartz-chalcopyrite-galena veins, and carbonate veins with pockets of pyrrhotite, pyrite, and sphalerite. Bleached pale grey to white siliceous rock is associated with abundant disseminated pyrite and also occurs adjacent to some pyrite veins. Pervasively bleached, pyritized, and silicified volcanic rocks occur locally and are difficult to distinguish from these bleached pyritic cherty rocks.

Copper with minor zinc mineralization occurs in massive pyrite and massive magnetite bodies. Massive mineralization apparently forms two large and several small lenses. Because the deposit is now subvertical, plan views at 1 800, 1 750, and 1 700 metres (Fig. 11a, b, c) are actually cross-sections while vertical sections along 9900N, 10050N, and 10200N (Fig. 12a, b, c) are longitudinal sections of the original deposit.

Metalliferous lenses are enclosed both in chert and in volcanic rocks. A rind of altered volcanic rocks lies along the eastern boundary of the ore 'system.' That is, the rind formed not only adjacent to the metal-rich lenses but also adjacent to the chert. Chert adjacent to massive sulphide zones on the east differs slightly from that on the west. Chert on the east has much black, carbonate (?) as fracture coatings and cementing breccia zones. Similarly, volcanic rocks adjacent to massive sulphides on the east are hydrothermally altered whereas those on the west are virtually unaltered. In the zone of hydrothermal alteration, primary textures of the volcanic rocks are masked by talc or carbonate alteration and black carbonate veining, by bleaching with local silicification, and by pervasive chlorite alteration. Thickness of the alteration zone ranges from 5 to 25 metres and its eastern border is gradational. Outside it are basalts, pillow basalts, and breccias similar to rocks seen west of the mineralizing system.

MASSIVE SULPHIDE BODIES

Pyritic massive sulphide bodies consist of pyrite with several per cent chalcopyrite and minor amounts of sphalerite. Banding of sulphides is uncommon but where it occurs consists of either chalcopyrite-rich layers or alternating bands of very finely crystalline and coarser pyrite. In many areas the pyrite looks clastic but fragmentation could be of either primary or tectonic origin. Chalcopyrite is interstitial, cements brecciated pyrite, and occurs in veins with quartz, calcite, pyrite, and sphalerite. The massive sulphide is also cut by quartz-talc (?) veins and, in one hole, by molybdenite stringers.

COPPER–ZINC DISTRIBUTION PATTERN

Copper-zinc distribution patterns are poorly developed in the deposit. From holes CC 1 to CC 21, the only ones for which both copper and zinc assays are available, an attempt was made to define a zoning pattern for the south massive sulphide zone. There is a relatively zinc-poor zone in the middle area and along its east side to the north. The west side in the northern area is relatively zinc enriched. Holes which penetrated the massive sulphide at greater depth also tend to be relatively zinc rich. The zoning scheme, though poorly developed, is in accord with the interpretation that the deposit faces west and the east side is its base. Zinc deficiencies suggest that the central area was close to the source of hydrothermal fluids. In many massive sulphide deposits, zoning from base to top is from zinc poor to zinc rich. Fringing mineralization also tends to be zinc rich. Therefore, zoning at Chu Chua, though poorly developed, suggests that the deposit faces west and that deeper mineralization is further from the feeder vent(s).

MAGNETITE LODES

A magnetite lode occurs near the base of the south massive sulphide zone and there is a magnetite-pyrite lode at the northern tip of the north zone. Near the contacts with pyritic lodes and where pyrite and magnetite are mixed, copper grades are like or better than those in pyritic lodes; in massive magnetite zones grades are poor.

Magnetite lodes typically contain pyrite and chalcopyrite with lesser amounts of chlorite, carbonate, and talc (?). Pyrite occurs as disseminations and forms veins in magnetite. However, magnetite-pyrite layers with both sharp and gradational contacts are found in pyritic massive sulphides and quartz-magnetite veins cut massive sulphides. Evidently pyrite post-dates magnetite in part but in part they overlap. In many instances contacts between pyrite and magnetite lodes are copper rich. In magnetite lodes there are pockets of carbonate, pyrite, and chlorite. Magnetite is veined by chlorite-feldspar (?)-pyrite, chalcopyrite-talc (?), chlorite-pyrite±chalcopyrite, carbonate (dolomite ?), magnetite-chlorite-quartz-pyrrhotite±chalcopyrite, and chlorite-pyrrhotite. Magnetite breccias are cemented by talc (?) or chlorite-pyrite±chalcopyrite.

GEOMETRY OF THE MASSIVE SULPHIDE ZONES

Plans and sections show that there are two major and several minor massive sulphide zones. Apparently the massive sulphides are lenticular and stratabound. On the 1 800 and 1 750-metre level plans the extent of the bodies is defined. They strike north and have subvertical to steep west dips. Below 1 750 metres, the north zone apparently pinches out but the south zone continues southward. There is a single magnetite lode at the south end of the south zone on 1 800-metre level. By elevation 1 750 metres there is a second magnetite lode near the east-central part of the south zone. This second lode has several metres of massive sulphide east of it and the main massive sulphide layer lies to the west. By elevation 1 700 metres, this magnetite lode has pinched out and cherty rocks separate the main and eastern massive sulphide layers; that is, at depth the south zone apparently splits into two discrete lenses.

DISCUSSION

Massive sulphide and magnetite lodes of the CC deposit are generally closely associated with pyritic, fine-grained, siliceous, often brecciated and locally laminated, cherty rocks. These rocks are over and underlain by basaltic, often pillowed, locally brecciated volcanic rocks. On the east side, the volcanic rocks are hydrothermally altered and the alteration fades to the east. It is interpreted that the alteration took place in the footwall lavas and therefore the deposit is proximal and faces westward.

The massive sulphides form lenticular layers which appear to be stratabound. Some pyrite appears to be clastic but relationships are not definitive. Chalcopyrite deposition usually slightly postdates that of pyrite. Banding in the zones is local and poorly developed. Zoning of copper and zinc is rudimentary but where best developed is in accord with tops to the west.

In several sections massive sulphides lens out down dip into cherty rocks. Similarly, on the level plans cherty rocks are seen to be closely associated with and along strike from massive sulphides. The cherty rocks are thought to be distal equivalents of the proximal massive sulphides.

Along the eastern margins of the south zone, hence early in the mineralizing episode, magnetite lodes were deposited. Magnetite-pyrite-rich areas also occur at the north edge of the north zone. As described by Large (1977), hydrothermal solutions of copper-pyrite ores are initially relatively highly oxidized. Mixing with seawater decreases temperature and oxygen fugacity. The deposition of massive sulphide, then magnetite, early in the mineralizing event suggests that mixing of seawater caused fO_2 to drop and the mixing curve to move into the magnetite field. In spite of further lowering fO_2, continued cooling would move the mixing curve back into the pyrite field (Fig. 13, curve A–B, following the method of Large, 1977). Magnetite-pyrite-chalcopyrite assemblages would develop where mixing paths followed stability field boundaries in fO_2-T space.

In summary, the CC deposit is a proximal massive cupriferous pyrite deposit that appears to be of the Besshi type. It is underlain by massive to pillowed basalts. Apparently the hydrothermal solutions which fed the proximal massive sulphide and magnetite lodes also caused deposition of more distal pyritic cherty exhalites. Ore deposition was either rapid or took place during a period of volcanic quiescence. Later, renewed activity covered the deposit with a thick pile of massive to pillowed basalts.

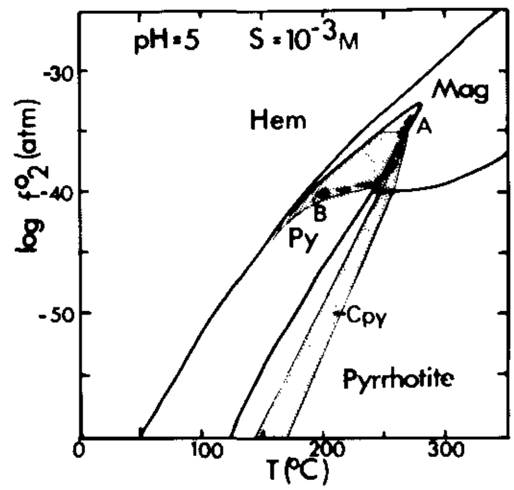

Figure 13. CC property, stability fields of Fe-S-O minerals in fO_2-T space for conditions assumed to be typical for cupriferous pyrite (Besshi)-type massive sulphide deposits (after Large, 1977). Line A—B represents theoretical mixing path to explain deposition of pyritic massive sulphide, then magnetite-rich lodes, then pyritic massive sulphide again from a cooling hydrothermal fluid. Note that nearly the total length of the path is in the chalcopyrite stability field.

ACKNOWLEDGMENTS

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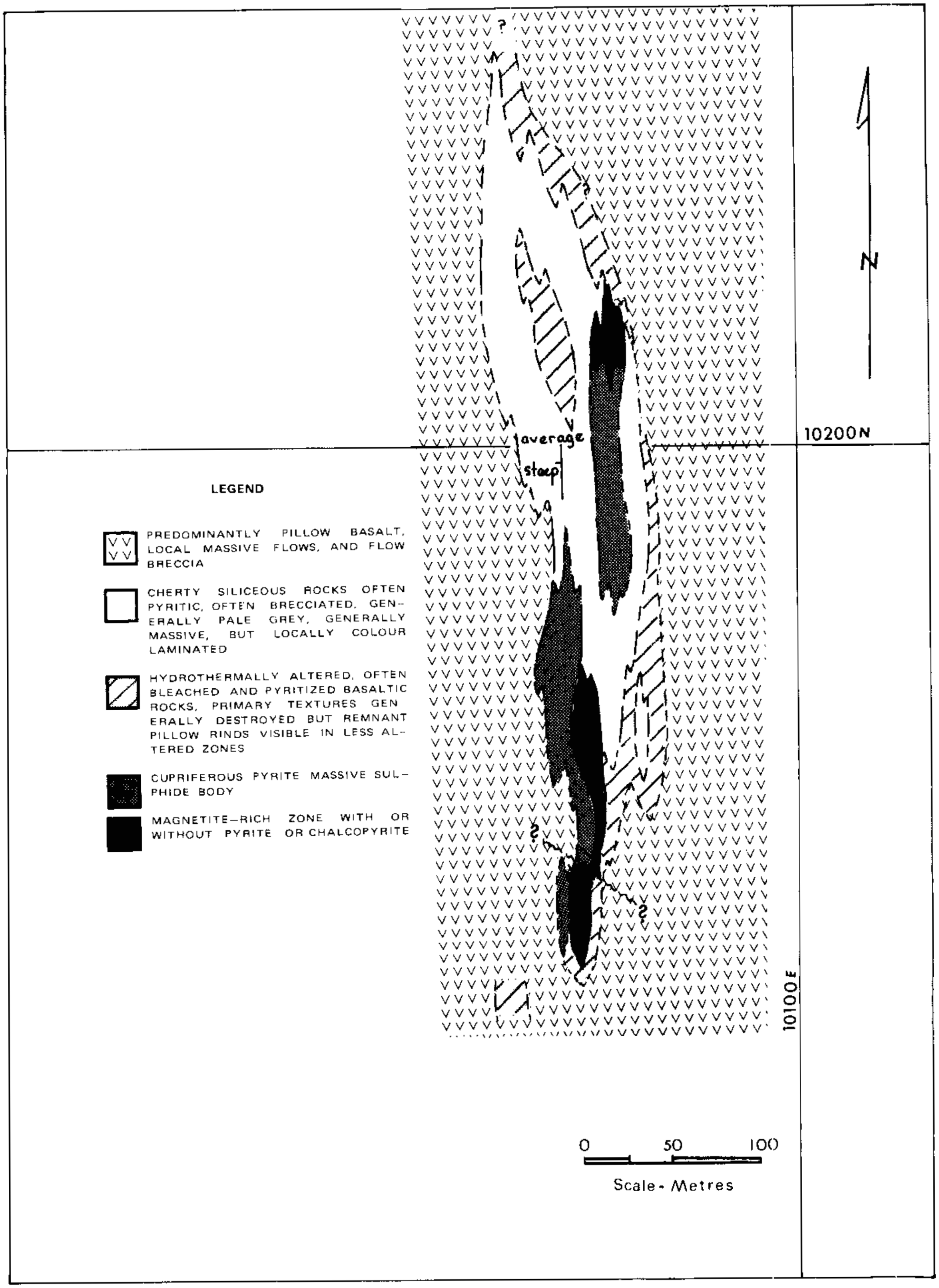

Figure 11a. CC property, plan view of geology and mineralization at elevation 1 800 metres (based on projections from drill-hole information).

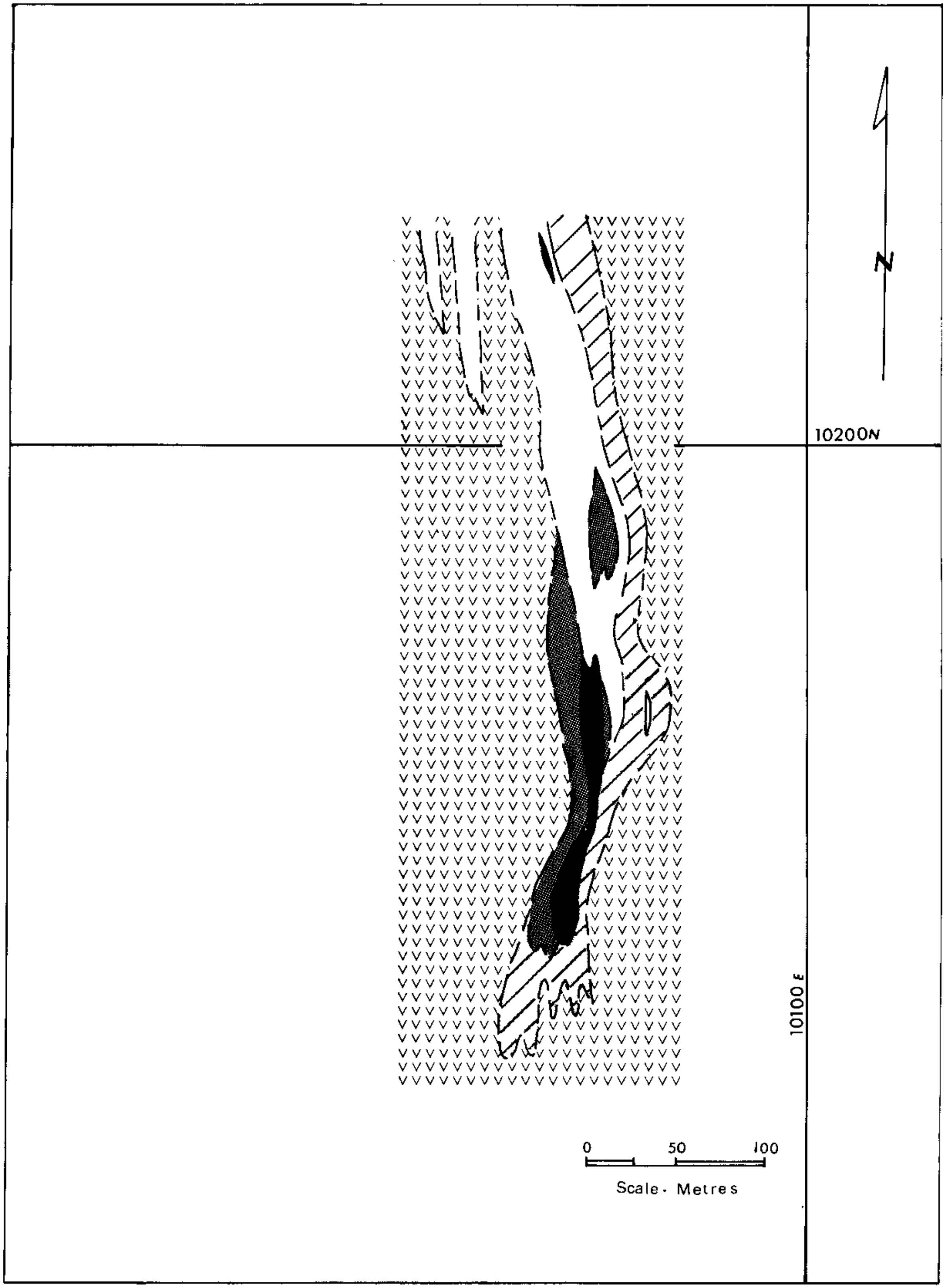

Figure 11b. CC property, plan view of geology and alteration at elevation 1 750 metres (based on projections from drill-hole information). For legend, *see* Figure 11a.

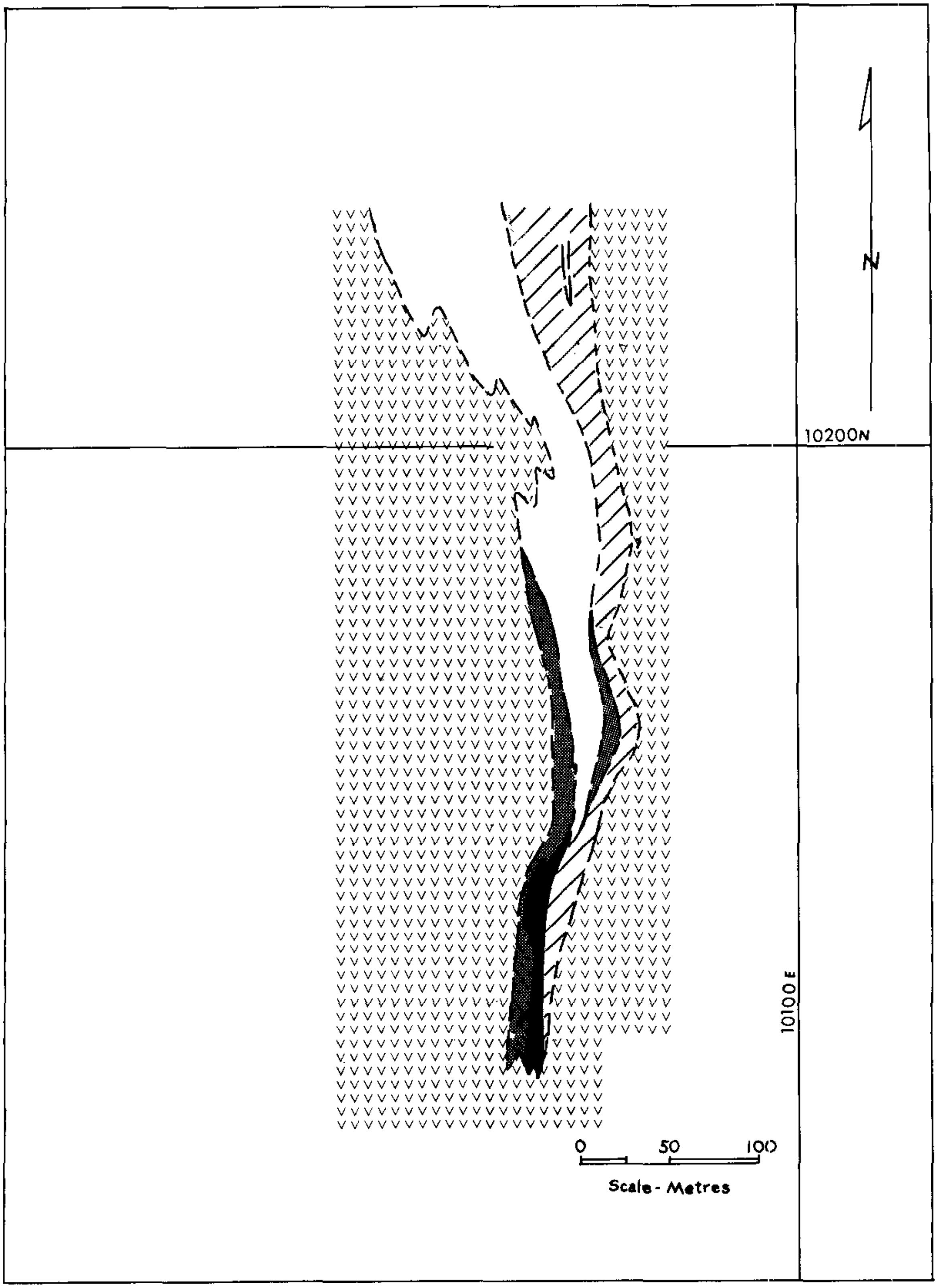

Figure 11c. CC property, plan view of geology and mineralization at elevation 1 700 metres (based on projections from drill-hole information). For legend, see Figure 11a.

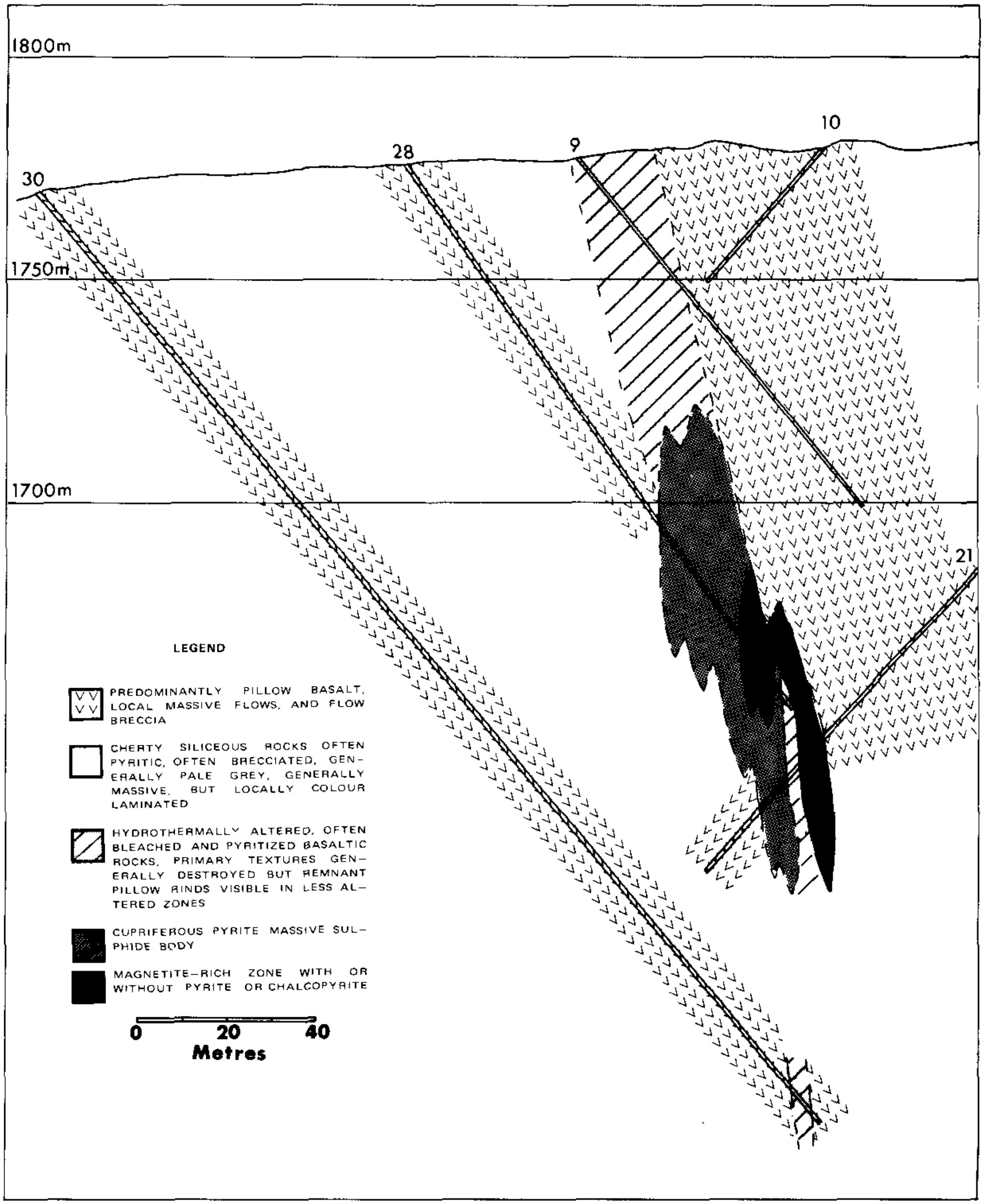

Figure 12a. CC property, geological section 9900N (looking north).

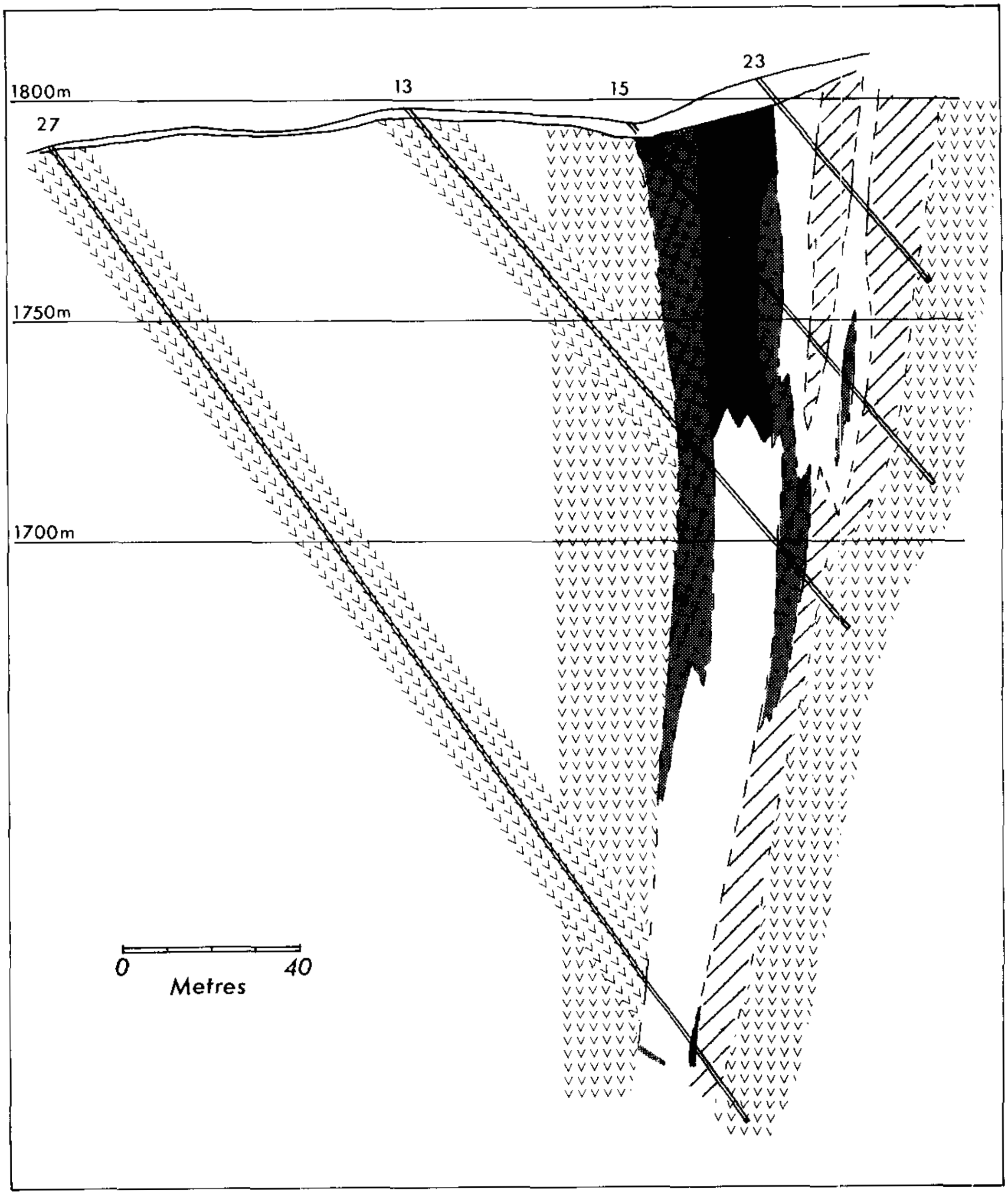

Figure 12b. CC property, geological section 10050N (looking north). For legend, *see* Figure 12a.

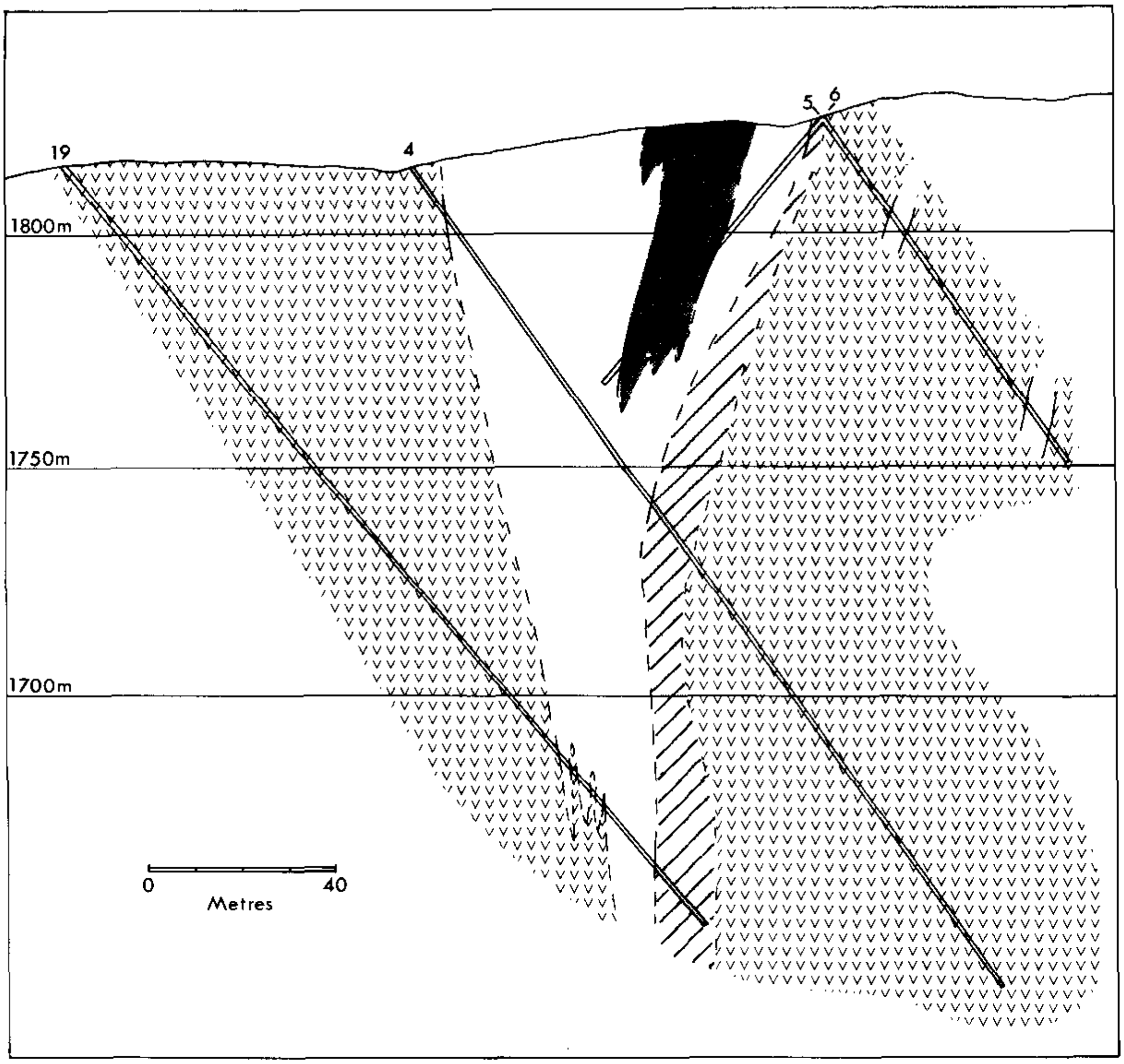

Figure 12c. CC property, geological section 10200N (looking north). For legend, *see* Figure 12a.