



**ELEMENT ZONING ASSOCIATED WITH GOLD MINERALIZATION AT CAROLIN MINE
(92H/11)**

By **G. E. Ray**
Ministry of Energy, Mines and Petroleum Resources
and
R.J.E. Niels
Carolin Mines Ltd.

INTRODUCTION

The Carolin mine gold deposit lies about 20 kilometres northeast of Hope in southwestern British Columbia. When production started in 1982 reserves were estimated at 1.5 million tonnes grading 4.8 grams gold per tonne, at a cutoff grade of 2.7 grams gold per tonne.

This report summarizes findings of a geochemical study of 50 core samples that were collected from two drill holes totalling 130 metres in length which crosscut a portion of the Carolin mine deposit (Fig. 43). These were analysed for both major and trace element contents to define any correlatable patterns of element zoning, and to determine whether broader halos of element enrichment or depletion are present. Drill hole IU-49, which is 35 metres in length, crosscuts a 9-metre-wide, gold-bearing, sulphide-rich horizon in the upper part of the orebody (Fig. 43). By contrast, drill hole IU-53 partially intersects another thicker but folded ore zone and extends 60 metres beyond the mineralization (Fig. 43).

MINE GEOLOGY

The Carolin mine gold deposit (the Idaho zone), is hosted in Jurassic metasedimentary rocks of the Ladner Group, close to both their unconformable contact with Early Triassic (?) greenstones and their faulted contact with ultramafic rocks of the Coquihalla serpentine belt. The replacement-type, sulphide-albite-quartz mineralization is preferentially hosted in wackes, lithic wackes, and, to a lesser extent, siltstones; thin slaty argillite units in the mine sequence are generally unmineralized (Ray, *et al.*, 1983). Underground mapping shows the complex orebodies are structurally and stratigraphically controlled (Shearer and Niels, 1983), being largely confined to favourable lithological horizons within the hinge portion of a major, asymmetric antiform. However, it is uncertain whether the mineralization preceded, accompanied, or followed the folding. The ore zones are characterized by a visual increase in both sulphides and multiphase quartz veining (Figs. 44 to 47), although not all horizons carrying these minerals are enriched in gold. Sulphides in the deposit average 6 to 8 per cent by volume (Shearer and Niels, 1983) and mainly

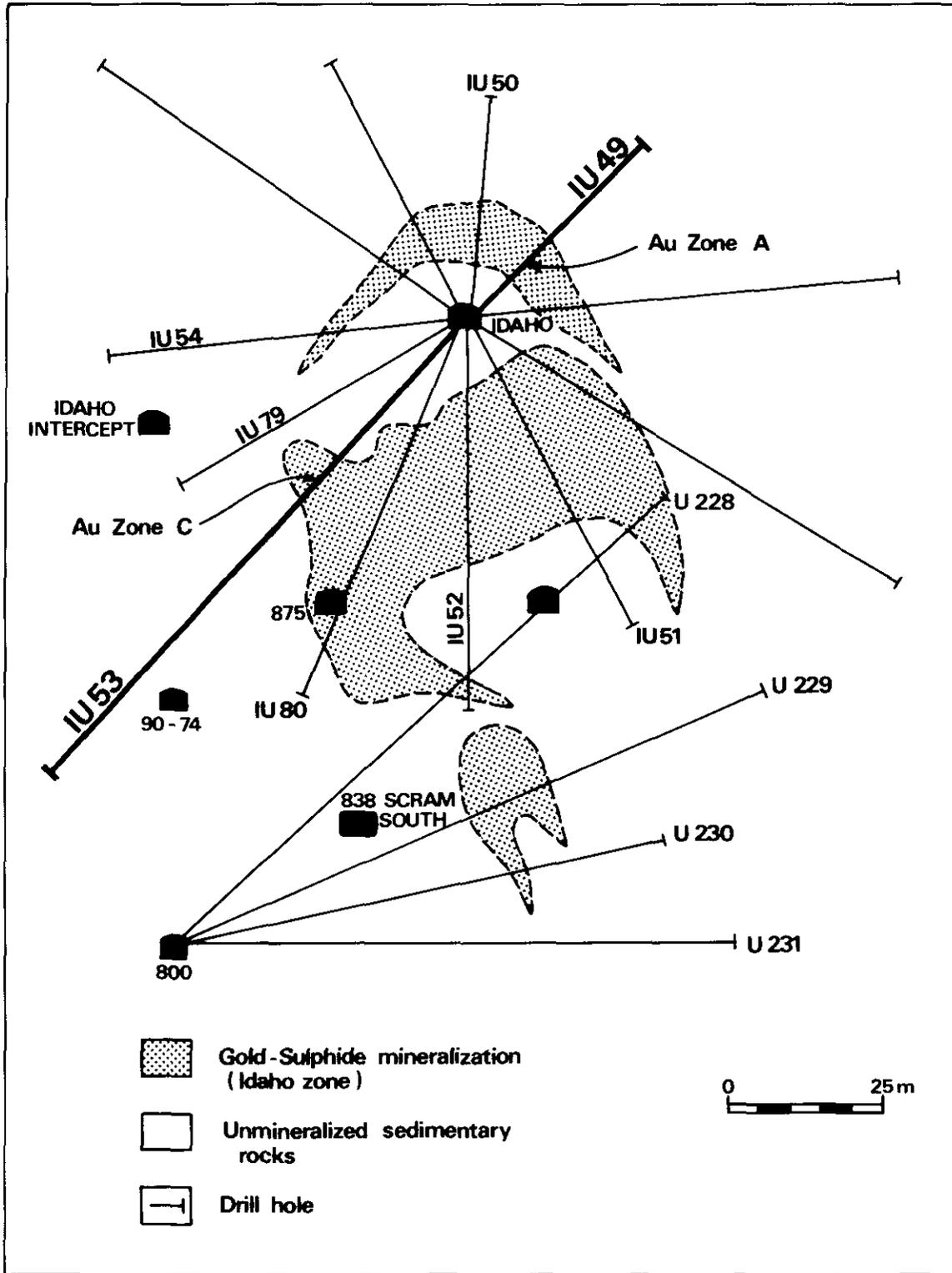


Figure 43. Longitudinal cross-section through the Idaho zone-837 North - showing location of drill holes IU-49 and IU-53 (adapted from data supplied courtesy of Carolln Mines Ltd.).

comprise pyrrhotite, arsenopyrite, pyrite, and magnetite. Less common metallic minerals, in decreasing abundance, include chalcopyrite, bornite, and gold (Kayira, 1975).

GEOLOGY AND GEOCHEMISTRY OF HOLES IU-49 and IU-53

The two drill holes intersect an interbedded sequence of finely bedded siltstone, and poorly bedded to massive wacke and lithic wacke (Figs. 44 to 47). The latter contains angular to subrounded, generally volcanic clasts up to 1 centimetre in diameter; individual lithological units in the drilled sequence vary from 1 metre to over 20 metres in thickness. Complex network veins of white quartz up to 3 centimetres thick, together with disseminations and veins of sulphides, are concentrated preferentially in some coarse-grained wacke and lithic wacke units. However, veins and clots of albite show no spatial association with the sulphide-rich zones, but are widespread and common throughout the two drill holes.

Four sulphide-rich, auriferous horizons are intersected in the two drill holes; a single 9-metre-wide zone in IU-49, while IU-53 intersected a narrow upper horizon, an 11-metre-thick middle unit, and a narrow lower zone. These are designated auriferous zones A, B, C, and D respectively (Figs. 44 to 47). Hole IU-49 passes through zone A (Fig. 43), but IU-53 only partially intersects the hinge portion of a folded orebody (zone C); thus it lies entirely within a repeated hangingwall sequence (Fig. 43). Consequently, the narrow mineralized units B and D may represent the same folded auriferous horizon, although their dissimilar geochemistry makes this unlikely.

Trace and major element geochemical plots for the two drill holes are shown on Figures 44 to 47. It must be noted that these are quantitative values and no allowance has been made for any volume changes, as described by Gresens (1967). In addition to the elements shown, analyses also were completed for Cu, Hg, P₂O₅, and SrO. While Cu was very weakly, but sporadically anomalous (up to 310 ppm Cu) in some mineralized horizons, the other three elements showed no anomalous values throughout the drill holes.

Ore zone A contains markedly higher gold values adjacent to its footwall and hangingwall sections, and a clear correlation between gold and silver is apparent (Fig. 44). Mineralization in this horizon is also associated with anomalous values of Mo, Sb, and As - the latter reflecting the presence of arsenopyrite. However, these three elements are concentrated preferentially in the hangingwall of zone A, while Mo, for example, is absent in the footwall. By contrast, none of the three auriferous zones intersected in IU-53 contain anomalous quantities of Ag or Mo.

Auriferous horizons A, B, and C are associated with wide barium depletion zones (Figs. 44 and 46). The barium is presumably associated with potassium feldspar, since depletion coincides with a drop in the

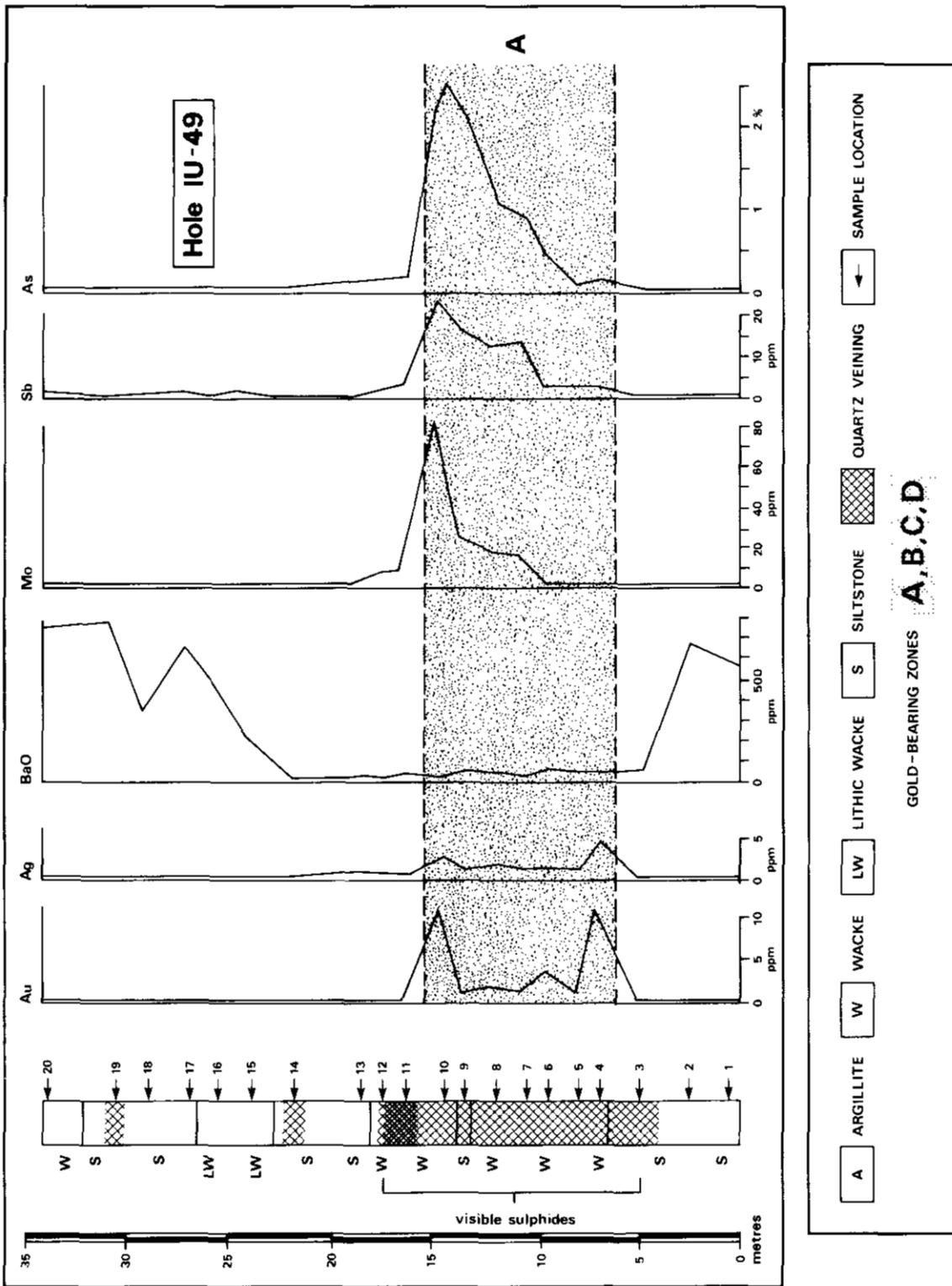


Figure 44. Geology and trace element geochemistry of hole IU-49, Carotlin mine.

potassium content (Figs. 45 and 47). As expected, the sulphide-rich zones in both holes are associated with a decrease in water content (H_2O+) and an increase in sulphur. Surprisingly, the total iron and titanium values drop in parts of zones A, B, and C. This is particularly noticeable adjacent to the hangingwalls of zones A and C where it reflects both the presence of arsenopyrite and the effects of dilution caused by an increase in silica and quartz veining. Silica and CaO generally correlate negatively throughout both holes; SiO_2 values increase sharply in the hangingwall portions of zones A and C, where quartz veining is abundant, but drops off in the footwall sections. These SiO_2 -enriched areas lie adjacent to narrow SiO_2 depletion zones situated in the country rock immediately above the hangingwalls of zones A and C. The MgO content decreases in the ore horizons, particularly in the hangingwall sections of zones A and C, but increases immediately above these auriferous horizons.

Compared to unmineralized Ladner Group siltstones and wackes outside the mine area, which average less than 4 per cent Na_2O , the entire 130-metre-long section of both IU-49 and IU-53 is anomalously enriched in sodium. Despite this, the relationship between mineralization and the sodium content is variable. Sodium levels rise moderately in parts of auriferous zones A and C, but drop in zones B and D. A narrow sodium depletion halo exists within, and immediately above, the hangingwall portion of zones A, C, and D (Figs. 45 and 47).

The relationship and distribution of elements within and adjacent to the gold-bearing zones A, B, and C show many common characteristics. By contrast, the lowermost auriferous zone D is geochemically unique; it is associated with a sharp drop in SiO_2 values, despite visible quartz veining, and with increases in CaO, total Fe, and TiO_2 (Fig. 47). Also, this zone is not associated with either barium or potassium depletion; instead the gold mineralization is marked by an increase in these two elements (Figs. 46 and 45).

CONCLUSIONS

Specific auriferous horizons at Carolin mine have complex and variable major and trace element zoning patterns in which gold is sometimes, but not always, associated with anomalous amounts of either Ag, Mo, As, or Sb. Most dramatic element changes generally occur within and immediately above the hangingwall sections of the ore horizons. The unique geochemical character of auriferous zone D, compared to zones A, B, and C, suggests that the Carolin mine orebody contains two mineralogically distinct ore suites.

The Carolin mine gold deposit is surrounded by a wide, sodium-enriched envelope that extends at least 60 metres beyond the mineralization. The lateral extent of this envelope is unknown and a program should be undertaken to establish its true dimensions. Lithochemical sampling

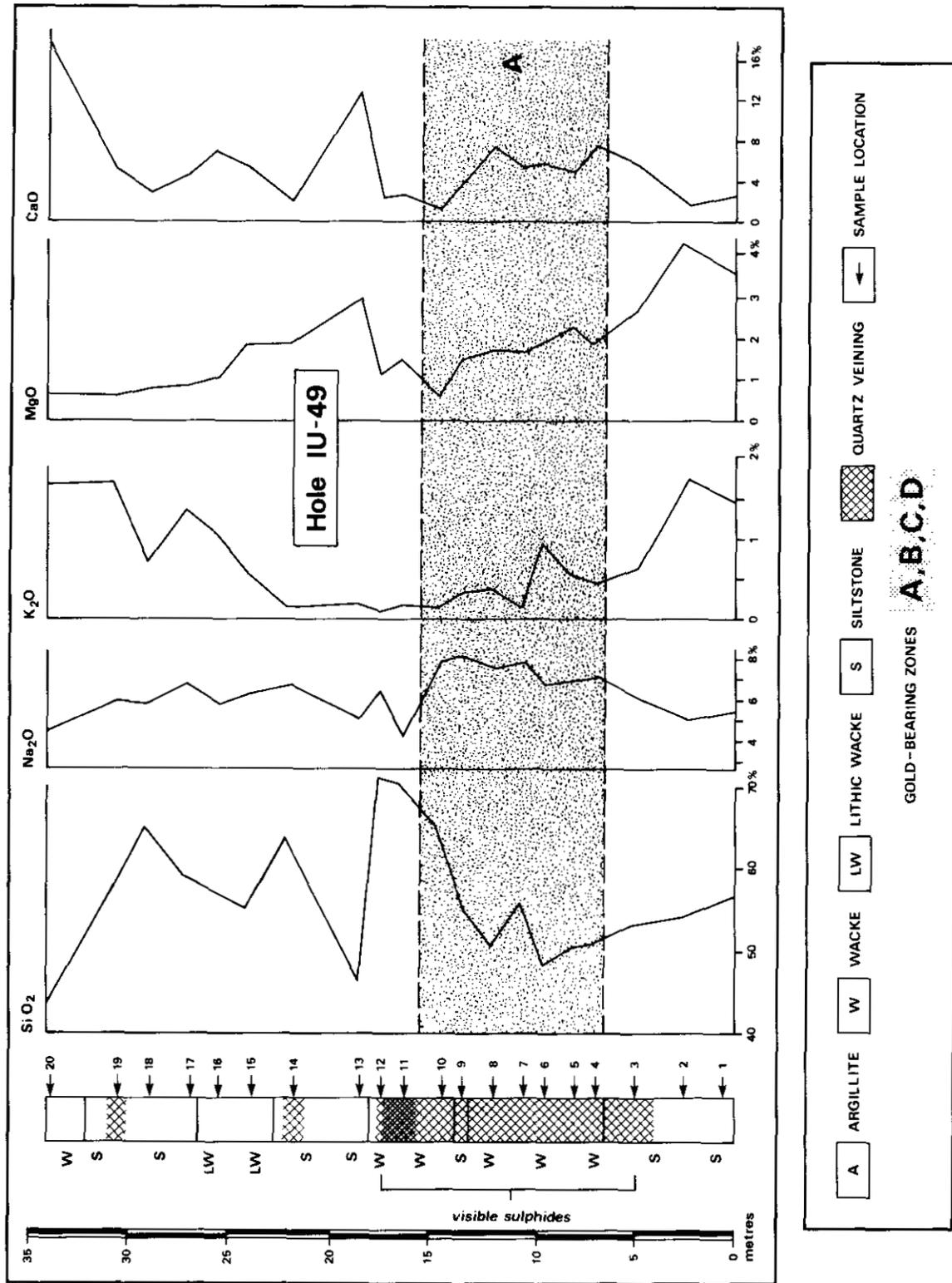


Figure 45. Geology and major element geochemistry of hole IU-49, Carolin mine.

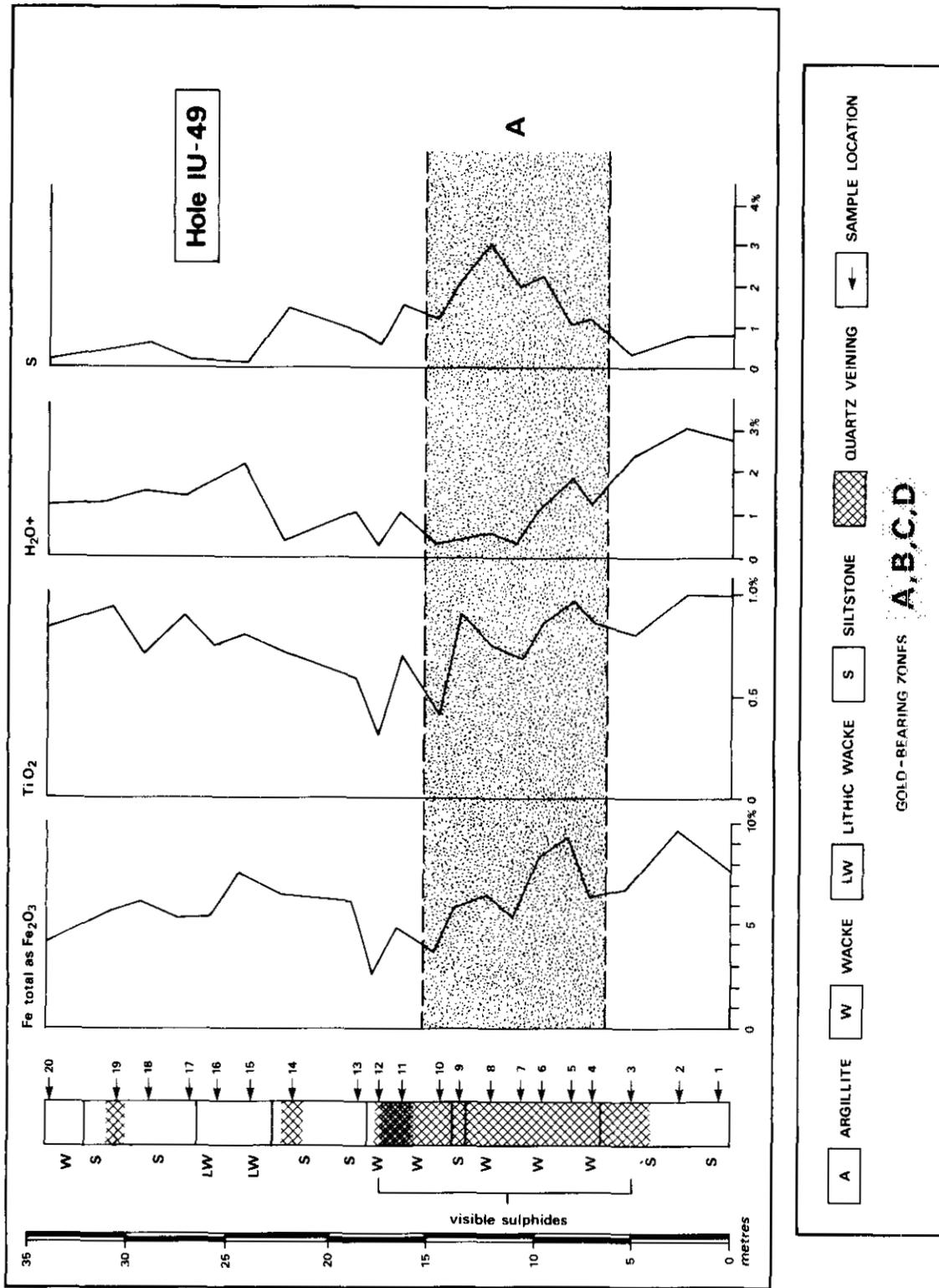


Figure 45. Geology and major element geochemistry of hole IU-49, Carolin mine.

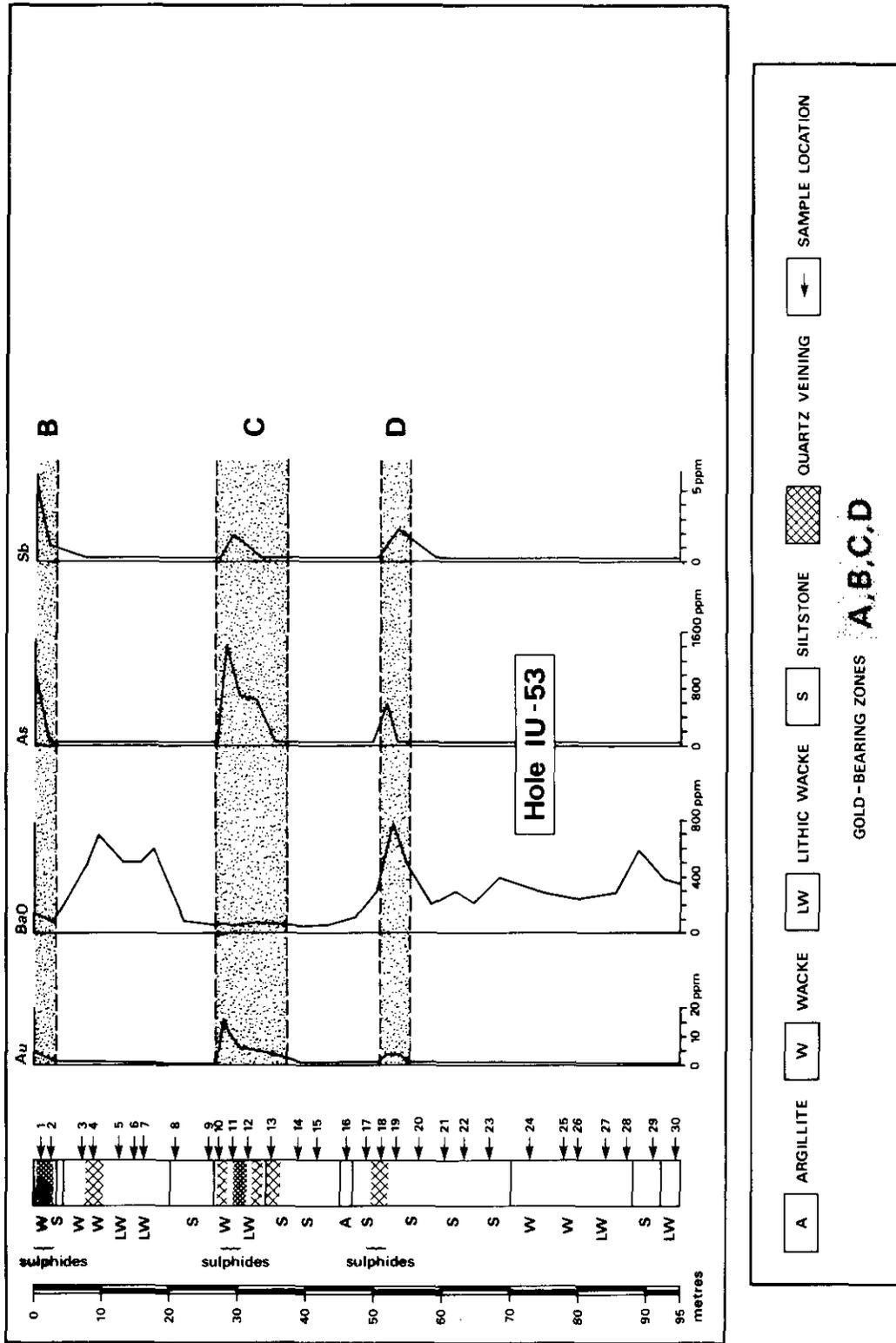


Figure 46. Geology and trace element geochemistry of hole IU-53, Carolin Mine.

to outline other areas of sodium enrichment probably represents a viable exploration tool for locating similar gold deposits in the district. Likewise, the barium and potassium depletion zones form valuable exploration drill targets since they are generally twice as wide as their associated gold-bearing horizons. Consequently, future underground drilling programs to locate extensions of the ore zones at Carolin mine should include routine barium or potassium analysis to test for any depletion in these elements.

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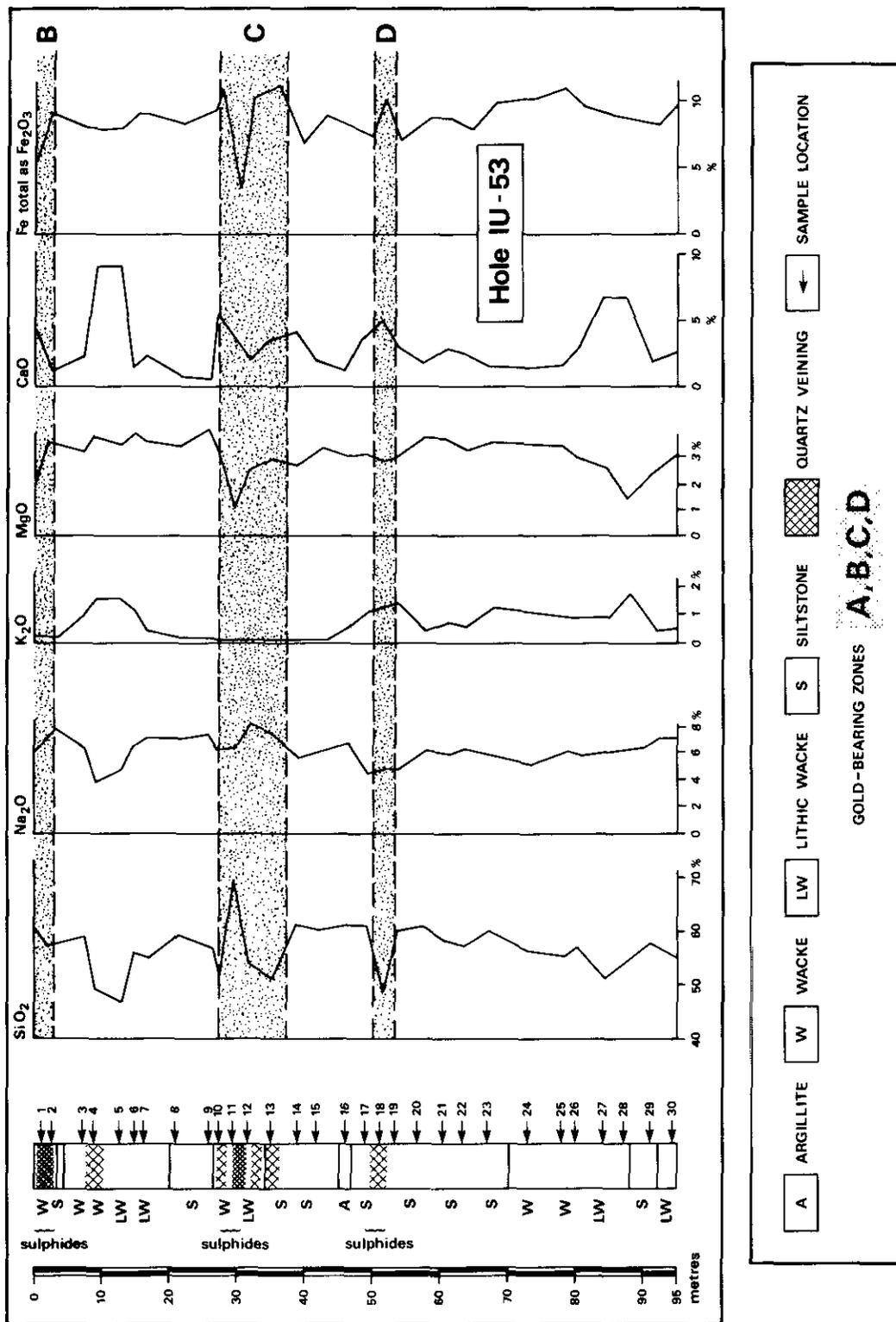


Figure 47. Geology and major element geochemistry of hole IU-53, Carolin mine.

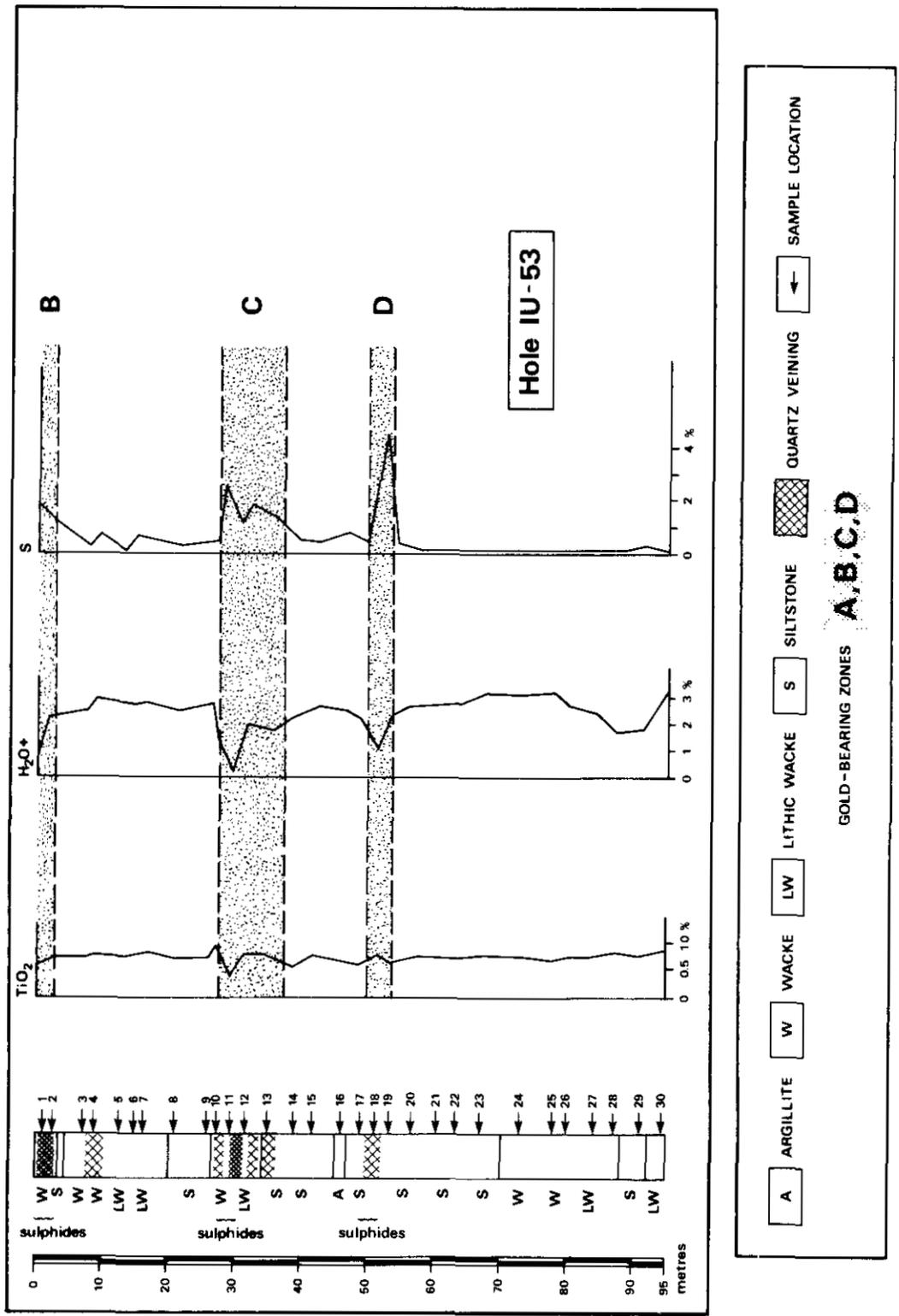


Figure 47. Geology and major element geochemistry of hole IU-53, Carolin mine.

