Source of salt in hydrothermal fluids based on Na-Cl-Br of fluid inclusions

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Ion chromatographic analyses of fluid inclusions from a diverse selection of hydrothermal ore deposits show that the source of salt in hydrothermal fluids can be discriminated on Na/Cl vs. Cl/Br plots. Previous studies [1, 2] have shown that saline inclusions in MVT [N=13] and sedex [N=1] Pb-Zn deposits are produced by the evaporation of seawater (Fig. 1 inset). Our data show that the fields for (1) magmatic hydrothermal deposits in deep to shallow environments associated with I- to S-type magmas [N=9] and (2) Phanerozoic mesozonal orogenic gold deposits [N=4] are distinct (Fig. 1); consistant with isotopic evidence for magmatic and metamorphic fluids in each class of deposits. These fields are used to evaluate the source of salt in other problematic deposits. Nevada Carlin-type gold deposits [N=4] plot within, or near, the field for orogenic deposits suggesting magmatic fluids were not important in their formation. Distal disseminated gold deposits [N=5] consistently plot within and outside the magmatic hydrothermal field suggestive of mixing between magmatic and external fluids. In the Donlin Creek district, the Dome Cu-Au deposit plots in the magmatic field and the paragenetically younger Lewis epizonal orogenic Au deposit plots near the orogenic field supporting a recent interpretation [3]. The results demonstrate the utility of fluid inclusion Na-Cl-Br data for ore genesis research.

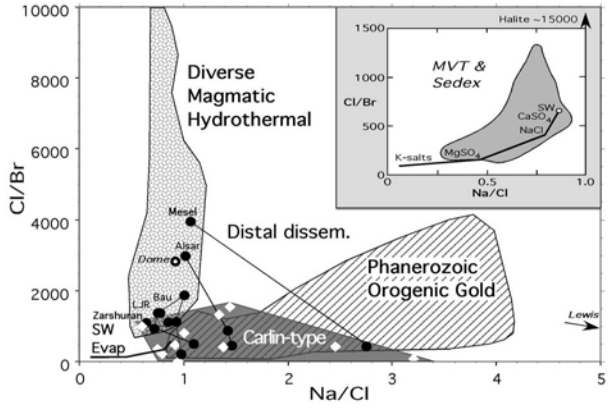

Figure 1: Na/Cl vs. Cl/Br of fluid inclusions.

References

[1] Viets J.G. et al., (1996), Econ. Geol. Spec. Pub. 4, 465-482.

[2] Leach D. et al., (2004), Econ. Geol. 99, in press.

[3] Goldfarb R.J. et al., (2004), Econ. Geol. 99, p. 643-671.

Devil Pike Brook gold deposit, south-central New Brunswick: An example of a mesothermal lode gold system in the Canadian Appalachians

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The Devil Pike Brook occurrence is a gold-bearing quartz-carbonate vein system hosted within greenschist-grade mafic volcanic rocks of the Grant Brook Formation (Mascarene Group) in south-central New Brunswick. Structurally controlled, quartz-carbonate veins are generally north-trending, but oblique to the regional NE structural trend. Three major drilling campaigns between 1994 and 1996 (59 drill holes) have defined three mineralized zones: “Baxter”, “16”, and the most significantly mineralized “Boyd” from north to south, respectively.

Average values of 15 mineralized samples have gold, silver, nickel and copper concentrations of 27 ppm, 7 ppm, 23 ppm, and 9600 ppm respectivley. Resampling of quartz-carbonate veins in drill core from the Boyd Zone has confirmed gold concentrations in excess of 80 ppm (2 samples of 25 and 30 cm in length). A 15 cm long channel sample across a quartz-carbonate vein exposed at the discovery trench (Baxter Zone) contained 47 ppm gold. Associated sulfide minerals identified include abundant pyrite, lesser chalcopyrite and reported minor sphalerite and trace arsenopyrite. The proportions of gold, silver, nickel, copper, zinc, lead, and tin in the Devil Pike Brook occurrence are comparable to other greenstone-hosted, gold-quartz deposits.

Multi-element lithogeochemical analyses (ICP-ES, ICP-MS, INAA) were conducted on 8 host rock samples and 29 quartz-carbonate vein samples (a total of 37 samples from 15 drill holes in 3 zones and 18 channel samples from one outcropping quartz vein). Pearson’s product correlation coefficient (r) on log results indicate a positive realtionship between gold and silver (r = 0.88), copper (r = 0.83), tellurium (r = 0.74), arsenic (r = 0.72), and sulfur (r = 0.72). Average sulfur and arsenic content in the 15 mineralized samples is approximately 4 wt% and 304 ppm, respectively. Average tellurium content in mineralized samples (8 ppm) is anomalous.