Mineral and Chemical Indicators of Vent Fauna Abundance in Modern and Ancient Black Smoker Ecosystems

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In the modern ocean, the most abundant vent fauna are localized on basalt-hosted black smokers in fast spreading MOR of the Eastern Pacific. Less fertile hydrothermal communities are associated with black smokers formed on basaltic and ultramafic substrates in slow spreading rifts. Scarce vent biota occur in black (gray) smoker ecosystems in back-arc and intra-arc basins of the Western Pacific island arc belt associated with basalt and dacite units. In ancient VMS deposits, sulfidized vent fauna have been found in well preserved sulfide mounds mainly located in mafic and bimodal mafic sequences. The abundance of vent fauna occurrence decreases with the growth in the role of felsic volcanic host rocks in the order of VMS deposit types: Cyprus → Uralian →Pontic → Kuroko and Altai (Iberian). In the same range of VMS deposits, assemblages of colloform pyrite, marcasite, isocubanite, pyrrhotite, and pyrite pseudomorphs after pyrrhotite become less common versus increasing amounts of barite, bornite, and fahlores.

In the range of VMS deposits discussed above, the contents of Se, Te, Co, and Sn decrease in hydrothermal chalcopyrite and sphalerite. The amounts of As, Sb, Pb, Tl, Te, Bi, Ag, and Au increase in hydrothermal-sedimentary colloform pyrite. We suggest that the oxidation state of hydrothermal fluids increases in the same direction. This assumption means there is a consequent reduction of the reduced gases (H_2S, CH_4, H_2) related to bacterial chemosynthesis. These changes are complicated by differences in maturity of hydrothermal systems within each type of VMS deposit. The faunal assemblages are more abundant in immature hydrothermal VMS systems. In mature hydrothermal systems the vent communities are scarce or absent due to the higher influence of toxic trace elements, especially Tl, Sb, and As.

These findings are consistent with the results of thermodynamic simulations using the program "Selector." Our model of hydrothermal maturation has been simulated in the system of seawater/basalt interaction (T 300°C, P 250 bar). The results suggest a major difference between the immature and mature stage of basalt alteration. In the immature stage, Fe, Se, Sn, and Co are leached from basalt. In the mature stage, the amount of leached As, Sb, Pb, Tl, Te, Bi, Ag, and Au are increased significantly. The leaching of Bi into the hydrothermal fluids appears to be due to the influence of magmatic SO_2 in mature hydrothermal systems only.

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