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Characterizing behavior of trace elements in source rocks using mathematical modeling

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It is observed that numerous gold deposits usually result from multiple stage mineralization in formation. The initial source strata is necessary for their formation, and may be distant from the final deposits. It is also observed that the abundance of gold in the metamorphic strata regularly decreases with increasing metamorphic grade. It may be depleted in migmatite by a factor of about one with respect to the low metamorphic grade equivalents or the inferred protolith. Why? This study concerns behavior of trace elements in source rocks using mathematical modeling.

It is shown in this study that the migration of impurity trace elements in source rocks strictly complies with hierarchical paths characterized by a fractal structure. There are two general tendencies for trace elements to migrate according to the embedded sink mosaic model. One is that trace elements tend to migrate out of solid cells and enriched in the weaknesses. Through various rank sinks, trace elements will finally joins a bulk aqueous solution filling in significantly large scale faults. The other tendency is from high temperature fields toward lower ones. High temperature and temperature gradient favor the establishment of these tendencies.

Reactivation of trace elements by diffusion is essentially a kind of short-range oriented mass transport within bulk solids and lower ranks of sinks. The path is the same as the migration tendency of a trace element in the embedded sink mosaic model. Despite the high effectiveness of infiltration and flow of fluids in transporting elements, diffusion is vitally important to the migration of a impurity trace element in source rocks.

Conjugate geochemical anomalies are an inevitable result of a closed material system. Two geological environments are especially promising in development of large scale conjugate geochemical anomalies: areas with highly contrast of temperature distribution, e.g., a metamorphic center and its surroundings, and a large fault system. Such conjugate anomalies, when superimposed on regional geochemical anomaly, could be an excellent guide for ore exploration and prospective assessment.

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