

Origin of ore-forming fluids at the Kalahari Goldridge deposit, Kraaipan Greenstone belt, South Africa: Evidence from strontium, carbon and oxygen isotope signatures in carbonates

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The Kalahari Goldridge lode gold deposit is located within the Archaean Kraaipan greenstone belt in the Northwest Province of South Africa. Gold mineralization is hosted in stratabound banded iron-formation (BIF). The mineralization is associated with two sets of gently-dipping quartz-carbonate veins which dip 20-40 ° W and strike approximately N6°W.

The mineralization is associated with extensive sulphidation, carbonatization, chloritization and K-metasomatism, and shows characteristic epigenetic style of mineralization. The carbon in the hydrothermal fluid based on C-isotope and fluid inclusion studies from the deposit does not provide a definitive source, as the range of the estimated isotopic composition of the ore fluid ($\delta^{13}\text{C}_{\Sigma\text{C}}$) of -6.0 to -7.8 per mil [1] overlaps the range prescribed for crustal and mantle sources (e.g., [2]).

To provide a more definite source and evolution of the fluid associated with mineralization, strontium, carbon and oxygen isotope studies were undertaken on carbonate samples including siderite, ankerite and calcite in quartz-carbonate veins from the deposit. The application of strontium isotopes in carbonates as ideal tracer elements in hydrothermal systems stems from the fact that the mineral partition Sr from the fluid substituting for Ca, but excludes Rb. Therefore, the present $^{87}\text{Sr}/^{86}\text{Sr}$ ratio in vein carbonates can be considered as the primordial. Thus, the Sr isotopic ratios in the carbonate remain unchanged after deposition.

Preliminary data of Sr isotope ratios obtained from 5 siderite samples range from 0.71154 to 0.73544 (average 0.71949). Although the ratio scatters in a wide range, the elevated initial Sr ratios in the carbonates are consistent with crustal origin. Given that the Rb/Sr ratios are negligible in carbonates to be responsible for the variation in the $^{87}\text{Sr}/^{86}\text{Sr}$ ratio, the wide variation may be attributed to selective incorporation of radiogenic ^{87}Sr into the ore-forming fluid. This may have been leached from deeper emplaced rocks by a hydrothermal system.

References

- [1] Hammond, N.Q., Moore, J.M., Sheets, R.W. (2006) *Ore Geology Reviews*, In press.
- [2] Ohmoto, H. (1986) *Rev. in Mineral.*, **16**, 491-559.