Trace Element and Sulfur Isotope Characteristics of the Star of Mangaroon Gold Deposit, Western Australia

Halik Rifki Daeng Taha[1], John Mavrogenes[1]
[1]The Australian National University, Canberra, Australia

The Star of Mangaroon (SOM) gold deposit, located in the Gascoyne Province within the Capricorn Orogen of Western Australia, is a historically significant yet underexplored gold system. This study presents the first detailed petrological and geochemical investigation aimed at characterizing mineralization processes at the SOM deposit. In situ textural, trace element, and sulfur isotope analyses were performed on representative pyrite using Scanning Electron Microscopy (SEM), Laser Ablation Inductively Coupled Plasma–Mass Spectrometry (LA–ICP–MS), and Sensitive High Resolution Ion MicroProbe (SHRIMP).

Pyrite was classified into five textural types: Py-MQZ, Py-Eu, Py-V, Py-TIG, and Py-VRM. Trace element data reveal variation across pyrite types, particularly in Co/Ni ratios. Py-MQZ and Py-Eu exhibit high median Co/Ni ratios (42.13 and 24.43), followed by Py-V (3.83), while Py-VRM and Py-TIG display much lower values (1.13 and 1.20). A consistent trend is observed from Py-Mqz to Py-VRM, marked by decreasing magmatic-related elements (Au, Ag, Bi, Te) and increasing metamorphic-related elements (Ni, W).

Sulfur isotope analyses yielded median $\delta^{34}S$ values of +4.66 ±0.3‰ (Py-MQZ), +5.04 ±0.8‰ (Py-Eu), +5.43 ±0.8‰ (Py-V), +5.57 ±1‰ (Py-TIG), and +6.28 ±0.5‰ (Py-VRM). These values indicate minimal isotopic variation and suggest stable physicochemical conditions and a common sulfur source. The progressive increase from $\delta^{34}S_{py}$_VRM > $\delta^{34}S_{py}$_TIG > $\delta^{34}S_{py}$_V > $\delta^{34}S_{py}$_Eu > $\delta^{34}S_{py}$_Mqz is attributed to isotopic fractionation, transitioning from magmatic to metamorphic influence.

The $\delta^{34}S$ values closely resemble regional granitic sources, particularly the Duchlacher Supersuite (+6.69 ±2‰), implying a granitic reservoir with fractionated sulfur. These isotopic signatures fall within the typical range for orogenic- and magmatic-related gold deposits (+5.4‰ to +11.5‰), such as in the Granites-Tanami Gold Province, supporting a granitic reservoir source for the SOM deposit.