Geophysical Research Abstracts
Vol. 17, EGU2015-8179, 2015
EGU General Assembly 2015

Multifractal spatial organisation in hydrothermal gold systems of the Archaean Yilgarn craton, Western Australia

Mark Munro (1), Alison Ord (1), and Bruce Hobbs (2)

(1) Centre for Exploration Targeting, The University of Western Australia, M006, 35 Stirling Highway, Crawley, WA 6009, Australia, (2) CSIRO Earth and Resource Engineering, Bentley, WA, Australia

A range of factors controls the location of hydrothermal alteration and gold mineralisation in the Earth's crust. These include the broad-scale lithospheric architecture, availability of fluid sources, fluid composition and pH, pressure-temperature conditions, microscopic to macroscopic structural development, the distribution of primary lithologies, and the extent of fluid-rock interactions. Consequently, the spatial distribution of alteration and mineralization in hydrothermal systems is complex and often considered highly irregular. However, despite this, do they organize themselves in a configuration that can be documented and quantified?
Wavelets, mathematical functions representing wave-like oscillations, are commonly used in digital signals analysis. Wavelet-based multifractal analysis involves incrementally scanning a wavelet across the dataset multiple times (varying its scale) and recording its degree of fit to the signal at each interval. This approach (the wavelet transform modulus maxima method) highlights patterns of self-similarity present in the dataset and addresses the range of scales over which these patterns replicate themselves (expressed by their range in 'fractal dimension'). Focusing on seven gold ore bodies in the Archaean Yilgarn craton of Western Australia, this study investigates whether different aspects of hydrothermal gold systems evolve to organize themselves spatially as multifractals. Four ore bodies were selected from the Sunrise Dam deposit (situated in the Laverton tectonic zone of the Kurnalpi terrane) in addition to the Imperial, Majestic and Salt Creek gold prospects, situated in the Yindarlgooda dome of the Mount Monger goldfield (approximately 40km due east of Kalgoorlie). The Vogue, GQ, Cosmo East and Astro ore bodies at Sunrise Dam were chosen because they exhibit different structural geometries and relationships between gold and associated host-rock alteration styles.
Wavelet-based analysis was conducted on 0.5m and 1m resolution down-hole gold assay concentrations, hyperspectral main mineral concentrations, alteration mineralogy composition (sericite) and structural feature (foliation, alteration and veining) intensity within the systems. The aim is to determine whether hydrothermal systems exhibit distinguishing multifractal signatures that may be used to quantify them, and differentiate system size, high-grade from low-grade, 'successful' versus 'unsuccessful', and proximity to mineralisation.