DISCRIMINATION OF PRECIOUS/BASE METAL MINERALISING SYSTEMS BY FRactal ANALYSIS, MT ISA, AUSTRALIA

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Fractal analysis of deposit and prospect distribution provides a new and valuable tool in interpreting mineralisation patterns and developing exploration strategies, as demonstrated here for the Mount Isa block in Queensland, Australia. The district is one of the world’s most richly endowed base metal provinces; it also has significant precious metal deposits. Genetic models for the base metal deposits have included syngenetic and epigenetic extremes. The comprehensive data base in the North West Queensland Mineral Province Report is used to analyse copper (n=1867), copper-gold (n=211), gold (n=80), zinc-lead-silver (n=186) and uranium (n=212) mineral occurrences, prospects, existing and abandoned mines. Spatial distributions are analysed by counting the number of boxes (N[r]) of size r containing one or more localities as a function of r. Spectacularly different relationships between N[r] and r are observed for the different metals. In all cases, the trend of N[r] with r becomes almost flat at values of r on the order of hundreds of metres. This “roll-off” effect may be due to lack of discovery of deposits. Relationships between N[r] and r at the largest box sizes may be influenced by a truncation effect. Approximate fractal dimensions (D) of the spatial distribution of each deposit type were evaluated avoiding both roll-off and truncation. The most clustered distributions were observed for Au (D ~0.29) followed by Zn-Pb-Ag (D ~0.41), U (D ~0.87), Cu-Au (D ~0.93) and Cu (D ~1.3). This implies that there are strong differences between the mineralising systems of Au and Cu, and that neither Cu nor Au is clearly related to the family of Cu-Au deposits in the district.

Au mineralization is highly clustered, implying localisation of mineralising fluid flow. In contrast, the Cu pattern indicates a more pervasive mineralising system. The latter
is compatible with popular models which suggest that fluid mixing led to copper deposition, and that both metal source and fluid transport are in principle available over wide areas, leading to relatively dispersed mineralization. The relatively low degree of clustering for the Cu-Au system is particularly intriguing. A recent model associating iron-oxide-copper-gold (IOCG) mineralization, in the Cu-Au group, with felsic plutonism, has been challenged on the basis of geochronology. Lack of clustering in this group supports additional/alternative models. Our data suggest that the Cu-Au mineralisation has common characteristics with the U mineralisation, possibly linking the Mary Kathleen U-REE deposit to the Fe-oxide-Cu-Au-(U-REE) family of deposits.