Periodic spacing of orogenic gold deposits*

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The concept that orogenic gold deposits are clustered and periodically spaced along regional-scale faults has much traction but remains ad hoc, having never been rigorously tested. In this study, we examine the spacing and clustering of orogenic gold deposits from a range of well-endowed and well-explored Archean and Paleozoic provinces. These are the Abitibi province, Canada; the Eastern Goldfields, Murchison and Southern Cross provinces from the Yilgarn Craton, Australia; and the Western Lachlan province, Victoria, Australia. Deposit data were collected from databases of the Geological Survey of Canada, Geoscience Australia, Geoscience Victoria and from scientific literature. The databases were checked for inconsistencies and updated with data published by mining companies. Deposit locations were verified using satellite images and published maps. In order to reduce sampling bias due to incomplete datasets, the data were filtered using a deposit size threshold consistent with the resolution of the compilations. Measurements were taken along regional-scale shear zones that are well constrained by field mapping, potential field data interpretation, and industry drilling. Deposits were grouped using a fixed threshold distance to define clusters, and the spacing between cluster centroids was then measured. To estimate uncertainty, a confidence interval was attributed to each result using a student t-test. Results were also compared using a two sample t-test.

Results show that a measurable, consistent periodic spacing does exist, which is anisotropic along the strike of well-endowed regional-scale shear zones - but the spacing distance and endowment of clusters can vary significantly between otherwise similar fault systems in different provinces. Furthermore, the spacing and endowment characteristics of gold deposits have an inverse relationship with greenstone belt thickness. This suggests that there may be a genetic link between mineralization processes and the volume of greenstone. In contrast, in the Yilgarn Craton, similar periodicities exist in different provinces, irrespective of whether the province was metamorphosed to greenschist or amphibolite grade. Therefore, metamorphic grade does not appear to be a controlling factor on spacing characteristics.

We argue that the processes that create the periodic spacing of gold deposits are self-organizing. The observed variation in periodic spacing of deposits for faults in different provinces is consistent with self-organizing phenomena, and may reflect subtle differences in the initial boundary conditions (e.g., thermal gradient, overpressuring, strain rate, etc.), which in turn determine different organized patterns of mineralisation in each mineral system.