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Nickel deposit density and endowment density models, Kalgoorlie Terrane, Western Australia.

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Mineral resource assessments are mainly concerned with estimating the number deposits and the amount of contained metal within an area. The United States Geological Survey three-part assessment framework, including its many variants, is one of the most widely used in mineral resource assessments. In the three-part assessment framework, the number of deposits per unit area (deposit density) in well explored regions (global control areas) worldwide is used to estimate the number of deposits in less explored geologically similar areas. The use of mineral deposit density models is premised on the existence of a power law relationship between deposit density and the areal extent of the host permissive geology that has been established in control areas of different deposit types worldwide. Using 12 local well explored komatiites (local control areas) within the Kalgoorlie Terrane, Western Australia, we show that that there is a power law relationship between the density of komatiite-hosted nickel sulphide deposits and the area of the host komatiites. We further demonstrate a power law relationship between the amount of nickel per unit area (nickel endowment density) and the area of the host komatiites. Implications of these findings are that: (i) demonstrability of the power law relationship at both the global and local scales may indicate that mineralization and deposit preservation processes could be approximately self-replicating at all scale, (ii) as the mineralization within a terrane is likely to be constrained by the geologic environment unique to that terrane, global density models may be viewed as providing general guideline estimates that may be less accurate than estimates based on locally derived density models, and (iii) metal endowment density models may be used to directly estimate metal endowment. This study shows that global geological relationships can be viably downscaled and adapted for application on local geological terranes.