

Regional Crustal Structures and Their Relationship to the Distribution of Ore Deposits in the Western United States, Based on Magnetic and Gravity Data

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Abstract

Upgraded gravity and magnetic databases and associated filtered-anomaly maps of western United States define regional crustal fractures or faults that may have guided the emplacement of plutonic rocks and large metallic ore deposits. Fractures, igneous intrusions, and hydrothermal circulation tend to be localized along boundaries of crustal blocks, with geophysical expressions that are enhanced here by wavelength filtering. In particular, we explore the utility of regional gravity and magnetic data to aid in understanding the distribution of large Mesozoic and Cenozoic ore deposits, primarily epithermal and porphyry precious and base metal deposits and sediment-hosted gold deposits in the western United States cordillera.

On the broadest scale, most ore deposits lie within areas characterized by low magnetic properties. The Mesozoic Mother Lode gold belt displays characteristic geophysical signatures (regional gravity high, regional low-to-moderate background magnetic field anomaly, and long curvilinear magnetic highs) that might serve as an exploration guide. Geophysical lineaments characterize the Idaho-Montana porphyry belt and the La Caridad-Mineral Park belt (from northern Mexico to western Arizona) and thus indicate a deep-seated control for these mineral belts. Large metal accumulations represented by the giant Bingham porphyry copper and the Butte polymetallic vein and porphyry copper systems lie at intersections of several geophysical lineaments. At a more local scale, geophysical data define deep-rooted faults and magmatic zones that correspond to patterns of epithermal precious metal deposits in western and northern Nevada. Of particular interest is an interpreted dense crustal block with a shape that resembles the elliptical deposit pattern partly formed by the Carlin trend and the Battle Mountain-Eureka mineral belt.

We support previous studies, which on a local scale, conclude that structural elements work together to localize mineral deposits within regional zones or belts. This study of mineral deposits of the western United States demonstrates the ability of magnetic and gravity data to elucidate the regional geologic framework or structural setting and to contribute in locating favorable environments for hydrothermal mineralization.