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The utilisation of magnetic susceptibility as a vector toward mineralisation in common rock and ore forming minerals.

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Aeromagnetic and ground magnetic surveys of mineral deposits and prospective terrain are a fundamental technique used in mining and economic geology. Inversion of survey data to source parameters (i.e., identification of ore zones) is often simplified by assuming a single, canonical or "average" value for the magnetic susceptibility of each mappable unit. In some mineral deposits, canonical magnetic susceptibility values for several dominant ore and accessory minerals will be used to calculate mineral concentrations, 3-D distributions, etc. In general, magnetic susceptibility is widely recognised by economic geologists as a fundamental, easily-measured tool used to better understand the prospectivity of ore deposits. Despite this, the quantitative application of magnetic susceptibility, in context of detailed ore petrology, is still a developing field yet one with great potential.

In order to assess to what extent, and in which systems, magnetic susceptibility is a vector toward mineralisation, we present aspects of an extensive database of single crystal and ore mineral aggregate samples. This reveals trends and magnitudes for several important rock-forming and ore-associated minerals during alteration, paragenesis, and enrichment.

For example, current literature canonical values show that the magnetic susceptibility for pure quartz is strongly diamagnetic but ranges between -1.78x10^{-5} and -1.00x10^{-5} (k, vol. SI). However, metamorphic bull quartz and chrysoprase are commonly paramagnetic, with common values for chrysoprase as high as 2.11x10^{-3}. In contrast, measurements from rose quartz samples are lower than those described for pure quartz with modal measurements as low as -2.08x10^{-5}. Measurements for rock crystal quartz form a distribution best described by the canonical diamagnetic value of -1.40x10^{-5}.

Modelling should take into account that rock crystal quartz is rarely the best petrological analogue at deposit-scale or in a quartzose terrain. The difference for calculated concentration of a targeted economic mineral in quartz, such as stilbite, can be quite profound as the lever rule applied to a notionally diamagnetic mineral (negative magnetic susceptibility) system dominated by quartz is even more sensitive than typical mass-balance binary systems.

Some ore mineral systems show no readily-used systematics in magnetic susceptibility-enrichment space; but for other systems, magnetic susceptibility is clearly a potential economic vector. Broad outlines of these different systems will be presented, in context of several examples, single mineral magnetic susceptibility distributions.