Mineral stabilities during deformation-induced mass transfer: Implications for alteration and sulfide parageneses and saturation in auriferous shear zones

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The paragenesis of alteration assemblages, in addition to phase equilibria evaluation coupled with an analysis of structural fabrics, is part of the study of shear zones, in particular those associated with gold mineralization. Preservation of the incremental mineral-chemical and structural features is problematic depending on the degree of overprinting, related to strain partitioning and fluid reaction history within the shear zone, i.e., the earlier shear zone history may be destroyed depending on relative competancy of each assemblage relative to microfabric development. In terms of alteration, reactivation of preexisting fabric elements controls the episodic fluid flow and indirectly the replacement of earlier minerals and their fabric elements.

Like silica solubility, differential stress enhances phyllosilicate stability relative to feldspar thus promoting hydrolysis reactions and incongruent solution of silica (Lentz 1999) at a given cation to hydrogen activity ratio. Therefore variations in stress can change silica activities in solutions associated with shear zones promoting silica solution or precipitation reactions. Silica solubilities are prograde, so silica precipitation should occur as replacement products or as quartz from buoyant fluids egressing along shear zones, especially if geostatic pressure decreases markedly during hydrofracturing or rock failure. However, many ductile shear zones have a relatively higher proportion of phyllosilicates reflecting pressure solution, although mineralogic changes evidently overprint these assemblages reflecting various silica precipitation reactions, especially in sulfide- and gold-bearing systems. Selective preservation of siliceous assemblages, due to competancy contrast, is evident during progressive fabric development (affecting micropermeability), i.e., inhibiting dissolution of these siliceous assemblages as the shear zone develops. Preservation of pyrite-arsenopyrite saturated in siliceous lithons, relative to pyrrhotite within micaceous domains, also reflects strain history; this has implications for gold saturation and remobilization during ductile shearing.

References

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Carbon, oxygen, and strontium isotope investigation of MVT Pb-Zn deposits in Kangdian area, China: Implication for ore genesis

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The MVT Pb-Zn deposits in Kandian area are hosted in carbonate rocks of Neoproterozic Dengying Formation and controlled by faults. Regionally extensive (~72,000km^2) carbonate rocks mainly consist of replacement dolomites. This study utilizes more than 100 C-O-Sr isotope data from the typical deposits and Denying replacement dolomites in the regional scale.

The δ^{18}O values of Dengying replacement dolomites (-5.083 to -11.948‰PDB), are more negative than the δ^{18}O values of carbonate rocks of Dengying Formation (-1.296 to -3.038‰). The δ^{13}C values of Dengying replacement dolomites (-1.967 to 3.087‰PDB) overlap the δ^{13}C values of Dengying carbonate rocks (+0.532 to +1.422‰). The shifts in δ^{18}O values between the replacement dolomites and the carbonate rocks suggest that Dengying replacement dolomites are the products of hydrothermal fluids, and this widespread development of dolomitization (~72,000km^2) requires high fluid-rock rations and a large-scale fluid flow system in the study area.

The δ^{18}O values of dolomite and calcite of ore-stage (-10.432 to -20.757‰PDB) are much more negative than the δ^{18}O values of Dengying replacement dolomites. The δ^{13}C values of these minerals (+1.878 to -5.300‰PDB) have a wider range than the δ^{13}C values of Dengying replacement dolomites. The ^{87}Sr/^{86}Sr values of calcite of ore-stage (0.71932~0.71425) are radiogenic and higher than the ^{87}Sr/^{86}Sr values of Dengying replacement dolomites (0.71005 to 0.70924). The δ^{13}C values of CO_2-and CH_4-dominated vapor phases within aqueous fluid inclusions of sphalerite and quartz have a range of: CO2, -19.50 to –0.36‰PDB; CH_4, -25.12 to –36.09‰PDB). The characteristics of these isotope compositions suggest influx of the δ^{18}O-depleted, organic matters, radiogenic fluids into the hydrothermal fluids responsible for regional scale dolomitizing of Dengying carbonate rocks, induced precipitating Pb-Zn ores. This mixed ore forming fluids may have obtained their radiogenic strontium signatures and organic matters through interaction with overlying Cambrian shales and clastic sediments during downward migration through faults and fractures.

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Reference

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