Trace element signatures in garnet from the Zhibula copper skarn, Gangdese belt, southern Tibet

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The Zhibula Cu skarn deposit comprises both exoskarn and endoskarn which occur as massive but narrow intervals within a Lower Jurassic volcano-sedimentary sequence containing limestone and at the contact with granodiorite dikes (17 Ma), respectively. Garnet compositions in exoskarn change from andradite (And)- to grossular (Gr)-dominant from the massive intervals to bands/lenses within marble/tuff, but not in endoskarn. In both cases however, associations at the protolith contact include anorthite and wollastonite, both indicative of skarnoid or distal skarn formation. Chondrite-normalised REY trends for garnet depict endo- to exoskarn diversity, And- vs. Gr-dominance and prograde-to-retrograde evolution in the same sample. The strong variation in Eu-anomaly, from positive to negative in And-dominant garnet can be correlated with the evolving salinity of ore-forming fluids. Trends depicted by And- and Gr-dominant garnets are consistent with published data from most skarns elsewhere, in which the dominant substitution mechanism for REY is YAG-type.

Zhibula garnets are enriched in a range of trace elements less commonly reported, including W, Sn, and As, but also Mo (as high as 730 ppm), a valuable finding that deserves evaluation in other skarns. Molybdenum, W, and Sn display excellent co-correlation and common zonation on trace element maps, indicating crystal substitution in garnet. Together with trace ore minerals, including coherent scheelite-molybdenite intergrowths, Au-Ag- and Bi-tellurides and Co-minerals, garnet compositions support a genetic connection between the skarn and the Qulong porphyry deposit located 2 km to the north. Trace element signatures in Zhibula garnets demonstrate the usefulness of this type of approach to establish genetic links between skarn and porphyry systems and to constrain skarn zonation and evolution in space and time.