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Temperatures from triple-junction angles in sulfides

JOHN LUSK,* BRIAN O. E. CALDER, AND TERENCE E. FREEMAN

Department of Physics, Macquarie University, N.S.W., 2109, Australia

ABSTRACT

Experiments carried out between 280 and 980 °C demonstrate that dihedral angles for galena, θ_{gn}, in sphalerite-galena-sphalerite triple-junctions decrease with increasing temperature, and that the rate of change increases in the same direction. Similar behavior is evident for sphalerite, θ_{sp}, in galena-sphalerite-galena triple-junctions, and also for pyrrhotite, θ_{po}, in sphalerite-pyrrhotite-sphalerite triple-junctions. Triple-junction thermometry (TJT) is therefore most sensitive at high to very high temperatures where isotope thermometers are least sensitive. The method relies on the temperature-dependence of competitive surface tensions between shared surfaces of intergrown minerals. Because chemical interaction is not a prerequisite, the TJT method is potentially applicable to a variety of mineral pairs found in regional metamorphic situations. The method requires a slightly modified microscope equipped with a precision X-Y stage.

The application of θ_{gn}-T (temperature) and θ_{po}-T calibrations to regionally metamorphosed sulfide ores yields temperatures that compare reasonably with temperatures obtained from sulfur isotopes and other geothermometers. Maximum regional metamorphic temperatures of ~470–480, ~590, and ~700 °C were obtained for the Bathurst (New Brunswick = greenschist facies), Ruttan (Manitoba = amphibolite facies) and Broken Hill (N.S.W. = granulite facies) deposits, respectively. The θ_{gn} and θ_{po} thermometers also reveal recrystallization effects in microfabrics.