# Sulfides in high-temperature to ultrahigh-temperature metamorphic rocks from Lutzow-Holm Complex, East Antarctica

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Behavior of sulfides during HT metamorphism has not been studied in detail until recently and, especially, study of sulfides during UHT metamorphism is scarce. We report the systematic difference of sulfide species between rock matrix and inclusions from Lutzow-Holm Complex (LHC), East Antarctica, and discuss the different mechanisms of sulfide evolution in rock matrix and in inclusions. The LHC is a Cambrian orogenic belt (Shiraishi et al., 1992) and progressive change of metamorphic grade from upper amphibolite facies to granulite facies is observed there (Hiroi et al., 1991). UHT conditions of ca. 1000C and ca. 11 kbar and subsequent isothermal decompression (ITD) are reported from Rundvagshetta (Kawasaki et al., 1993; Motoyoshi and Ishikawa, 1997). Basic and felsic rocks from 6 headlands and coastal platforms including Rundvagshetta were studied in detail. Sulfides commonly observed as matrix minerals in felsic and mafic rocks are pyrite (Py), chalcopyrite (Cpy) and pentlandite (Pent). Sulfide assemblages in felsic rocks include Py, Cpy, Py+Cpy, Py+Pent and Py+Cpy+Pent, and those in mafic rocks are Py, Cpy, Py+Cpy and Py+Pent. Pyrrhotite (Po) is rarely contained as a matrix mineral, but if contained, the rock contains Po as inclusions as well. Sulfides inclusions are found in Grt, Qtz, Pl, Opx (these 4 both in felsic and mafic rocks), Sil (in felsic rocks), Cpx, Bt and Hb (these 3 in mafic rocks). Sulfides located in other mineral but connected to rock matrix via crack are not dealt as inclusions. Inclusion sulfides are Po coexisting with or without Pent and/or Cpy. Py or Cpy by itself never occur as inclusions. Because Pent and Cpy commonly show lamella texture, we consider that bulk composition of the inclusion sulfides represent original composition of one sulfide phase when it was entrapped. Utilizing modal ratio, density and compositions of sulfides, original inclusion sulfide composition was reconstructed. Matrix sulfide compositions are also recalculated in the same way, but it should be noted that matrix minerals can be affected by later fluid activities. The reconstructed inclusion sulfide compositions in felsic rocks are plotted between Po and Cpy and those in basic rocks are plotted between Po and Pent. Sulfide inclusions in UHT metamorphic rocks show wider range of solid-solution compositions than the HT rocks. The inclusion composition that is projected from Pent and Cpy is Po (NFeS=0.95). Minerals hosting the inclusions with extreme solid-solution compositions are Opx (coexisting with Sil+Qtz) and Grt in felsic rocks, and are Opx, Cpx, Hb and Grt in mafic rocks. As these minerals are stable at the metamorphic peak, inclusion sulfides probably preserve original composition at peak metamorphism. The recalculated composition of matrix sulfide aggregates plots between Py and Cpy or between Py and Pent. Considering the evolution of Po (NFeS=0.95) during cooling of the rocks with log(fS2)-temperature diagram, Po (NFeS=0.95) crosscuts the Po/Py boundary around 550C at 10 kbar. On the other hand, Po (NFeS=0.95) does not crosscut the Po/Py boundary until below 300C at 1 bar. This implies that Po is likely to survive and does not change to Py if the rock experienced ITD. Because of ITD, Po is preserved as inclusions in LHC. Matrix sulfides should be Po if the system is closed with sulfur. However, common occurrence of Py instead of Po implies that retrograde fluid activity almost completely changed the sulfide assemblage in the rock matrix. We suggest that inclusion sulfides preserve original information when they were entrapped, but matrix sulfides are completely changed from original ones. Metamorphic rocks cooled down in the depth are more likely to experience Po to Py change (even inclusion sulfides experience this). Rocks with ITD path tend to preserve Po as inclusions and that with isobaric cooling path are likely to experience Po to Py change except for Po with high NFeS values.