Typomorphism of pyrite of the gold mineral deposit

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The changeability of the typomorphic characteristics of pyrite is pronounced in the quartz veins of the Sarala gold deposit of the Kuznetsk Alatau (East Siberia). Pyrite is the most widespread mineral of the sulphide-quartz ore of the deposit.

The chemical composition of the mineral is extremely variational, the S/Fe ratio changes from 2.015 to 1.945. Pyrite with the S/Fe ratio < 2.0 dominates for the top level of the deposit, S/Fe > 2.0 for the low level. The less stoichiometry pyrite is contained in the richest gold-bearing ore.

Concentration of gold in the ores depends on chemical composition of pyrite as C_{Au}(ppb) = 103542 (lg S/Fe)^2 – 61949 (lg S/Fe) + 9269.

There are 13 mineralogical types of pyrite crystals in the ore. The crystals of cube and cube-pentagon-dodecahedral habit are the most well- and wide-developed. The most rich gold-bearing ore is characterized by presence of the greatest quantity of the morphological types of the crystals.

The elementary cell parameter a_0 of pyrite is variated from 5.4142 to 5.4213Å. Parameter a_0 = 5.416 – 5.419Å characterizes the crystals of pyrite with S/Fe=1.995–2.005, if the ratio is S/Fe>2.010 or S/Fe<1.985, parameter a_0 is about 5.4213Å. Correspondence between chemical and structural level of stoichiometry of pyrite is discovered.

Ni and Co cations replace Fe cations. Cations of As and Au replace cations of S in the mineral structure. Ag replace Fe, if S/Fe is changed from 1.950 to 1.985, and if S/Fe>1.985, Ag replace S.

The naturally determined alteration of the typomorphic characteristics of pyrite is observed by us for other deposits as well. This phenomenon may be used for description of a gold-bearing level and zonality.

Deep subduction fluids and their interaction with the mantle wedge

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The role of subduction fluids in mantle metasomatism has been increasingly recognized in the last decade. Valuable input has come from studies of high- (HP) and ultrahigh-pressure (UHP) rocks. Here we present natural examples of slab dehydration and fluid-peridotite interaction during subduction. Serpentine breakdown, a main dehydration event in slabs, is recorded by chlorite harzburgites (Spain; Central Alps), which retain the antigorite breakdown fluid in primary inclusions enriched in LILE, B, Li relative to HFSE and similar to arc magma signatures [1]. Interaction of this fluid with metabasaltic, sedimentary or granitic slab rocks, may produce hydrous melts or silicate-rich fluids, viewed as the main transport agents of material released from the slabs. Their fate in the mantle is yet unconstrained, however. Useful information can be gained from studies of UHP garnet peridotites, representing wedge materials sliced into the subducted crust. Garnet orthopyroxenites from Dabie-Shan (China) derive from harzburgites which reacted with siliceous slab agents to evolve aqueous fluids trapped in primary LREE- and LILE-rich inclusions in garnet [2]. This suggests that subduction agents react with the mantle to release mobile aqueous fluids. Deep (200 km) C-O-H fluid infiltration in the mantle is recorded by the UHP garnet websterites of Western Norway. These contain majoritic garnet veins and host diamond-bearing inclusions [3,4]. The trace element signatures of minerals and inclusions point to crustal metasomatism, which calls for crustal recycling via fluid phases down to 200 km depths in subduction zones. Fluid-enhanced mantle refertilization during subduction is thus increasingly recognized in natural samples, emphasizing its relevance in global geochemical cycling.

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