Geochemistry of biotites from granitic rocks of Ciborro – Aldeia da Serra, Ossa-Morena Zone (southern Portugal)

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The Ciborro - Aldeia da Serra area is located in the Ossa-Morena Zone of the Iberian Massif [1]. This massif corresponds to the south-western extension of the European Variscan belt.

Biotite>amphibole tonalite, biotite>amphibole granodiorite, biotite trondhjemite, one biotite>amphibole granodiorite and two biotite granodiorites, biotite granite and two biotite>muscovite granites crop out in the area. Microgranite veins, rhyolite porphyries and aplite-pegmatite veins intruded all the granitic rocks.

Biotite is the most abundant mafic mineral in tonalite and one granodiorite and the only mafic mineral in the other granitic rocks ranging from trondhjemite to granite. It is subhedral, strongly to moderately pleochroic. In general, it shows strong undulose extinction, evidencing intracrystalline deformation [2], except in one of the biotite granodiorites. It is locally altered to chlorite. Biotite compositions were determined by electron microprobe and show their geochemical characterizations and discrimination of the granite magma in which they have formed. Biotite from tonalite is Mg^{2+}- biotite with $Mg/(Mg+Fe^{2+}) = 0.55$. On the other hand, biotites from the other granitic rocks are Fe^{2+}-biotites with $Mg/(Mg+Fe^{2+})$ ranging from 0.34 to 0.50. All biotites are of magmatic origin. Plotted in the ternary diagram total FeO-MgO-Al_2O_3 and total FeO versus MgO diagram of Abdel-Rahman [3] biotite compositions of metaluminous (A/CNK = 0.95) tonalite fall in the field of biotite from calc-alkaline rocks, whereas biotites from the peraluminous (A/CNK from 1.03 to 1.09) granitic rocks fall in the field of biotites from peraluminous rocks.

[1] Lotze (1945) *Geotektonische Forschungen* **6**, 78-92 [2] Passchier & Trouw (2005) *Microtectonics*, Springer-Verlag, Berlin Heidelberg. [3] Abdel-Rahman (1994) *J. Petrol.* **35**, 525-541.

Thermodynamic parameters and hydrochemical zonality

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Hydrochemical zonality (Tolstixin N.I., Zaycev I.K., Gurevitch M.S) is based on data of salinity change with depth. It occurs gradually and its non-conformity depends on geology and hydrodynamics of groundwater basins. Rock composition and volume of filtered water is a basis for physic-chemical modeling. Therefore, looking from "water-rock" system point of view we suppose to show correspondence of hydrochemical zonality to thermodynamic parameters which are responsible for transformation of chemical composition of ground waters.

The thermodynamic modeling of flowing groundwater composition is done by ‘step reactor’ technique. The calculations were carried out using HCh program complex developed by Shvarov Y.V. (Russia, MSU). The hydrodynamical processes were taking into account by modeling parameter R/W (weight ratio of reacting solids and aqueous phase of the “water-rock” system). In modeling procedure the change of a saturation of groundwater was studied within one water-bearing horizon, where the areas with fixed physical (homogeneous T-P parameters, hydrodynamical gradients etc.) or chemical conditions (one hydrochemical type of water) can be allocated. Such work is done on an example Moscow artezian of basin (for yasnopolianskogo and serpuxovsko-okskogo water-bearing horizons). It has happened that groundwater is oversaturated in respect to dolomite. The saturation is reduced along the groundwater flow from source area to transit one. It is obviously possible to explane the revealed factor as decreasing of solid cations and anions concentration due to aqueous complex formation growth with more salinity The correlation of oversaturation is revealed positive interrelation with hydrocarbonate (0.98) and Eh (0.51), whereas with salinity - negative one (-0.53). So it is the third group of the factors (after hydrodynamical and geochemical ones), which influences on redistribution of chemical components of flowing groundwater of the ‘water-rock’ system. The obtained hierarchical structure of the factors of groundwater chemical composition transformation improves groundwater quality forecast by modeling dynamic hydrogeochemical systems.

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