EPSC Abstracts
Vol. 5, EPSC2010-75, 2010
European Planetary Science Congress 2010

Petrology of ringwoodite bearing pumices of the El Gasco region, West Spain.

Glazovskaya L. I(1), Feldman V.I (1)
(1)Petrology department, geological faculty Moscow State University glazov@geol.msu.ru

The pumice rock outcrop of El Gasco is located in Sierra de Gata Mountains, western Spain. The pumices are distributed near the mountain peak over an area of 30 x 70 m. They are represented by fragments up to tens of centimeters in size. Some fragments have surface cracks (bread crust). The rocks are traced to a depth of at least 1 m. Host rocks are quartz – mica sandstones of Late Proterozoic age, which are widespread in the region. In terms of major and trace element composition, the pumices completely correspond to quartz–mica sand stones. Thus, they are products of the melting of quartz–mica sandstones. Two genetic hypotheses were proposed to explain the melting process that produced the pumice for the last years of investigation: (1) as a result of vitrification due to standing fire of a human made structure constructed with local wood and stones (vitrified hill-forts) [1,2] (2) as a result of meteorite impact [3]. The finding of ringwoodite [4] makes it possible to solve the problem of the genesis of pumices.

Results. The presence of Fe- ringwoodite (Fig. 1) was confirmed by electron backscatter diffraction (EBSD) analysis at the Instrumental Analytical Laboratory in Oxford. This method makes it possible to determine the symmetry and unit cell parameters in a single grain using thin sections. Since EBSD analysis involves etching of ringwoodite and ringwoodite occurs as an intergrowth with spinel in some pumice sections, the grain composition was additionally examined on a microprobe after the EBSD analysis.

Unit cell parameters of the studied mineral coincide with those of Fe-ringwoodite from the ICSD database having a cubic cell with **a = 8.2413 A, b = 8.2413 A, and c = 8.2413**

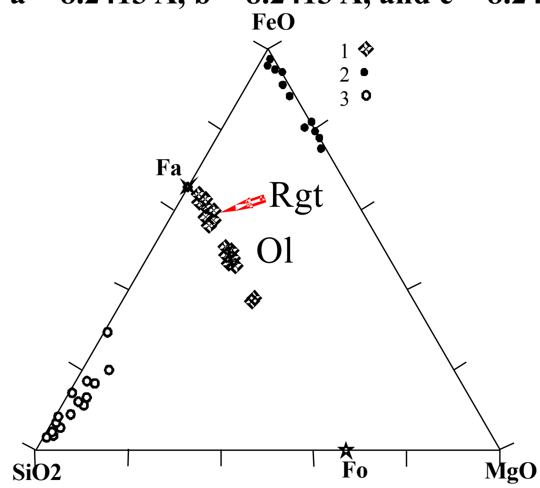

Fig 1-Diagram composition of glasses (1) and minerals (2- spinel, 3- Fe-ringwoodite (Rgt) and olivine (Ol)-ferrohortonolite) from pumices of the El Gasco region.

The composition of this ringwoodite grain is represented on fig 1. In addition to this variety, more magnesian ringwoodites were also identified in the El Gasco pumice. However, their unit cell parameters were not determined. Actually, this was the first finding of ringwoodite in rocks of the Earth's crust. Ringwoodite in pumice El-Gasco was also confirmed by micro-raman spectroscopic study [5]. Ringwoodite, a cubic dimorph of olivine, has been synthesized under high pressure within 6–24 GPa [6] and found in meteorites. Also was determined olivine Fa 80 (ferrohortonolite) with using electron microscopic investigations (JEM-100C microscope equipped with EDS Kevex 5100) in the obtained suspension preparations. The composition of particles obtained in our experiments was more magnesian than ringwoodite, crystal lattice had an orthorhombic symmetry with **a = 4.8 A, b = 10.6 A, and c = 6.2** Thus, two olivine polymorphs (ringwoodite and ferrohortonolite) crystallized in the El Gasco pumice during the pressure decrease and rapid cooling of melt. In addition to these minerals, the melt also produced spinel (hercynite) (Fig.1) with the iron mole fraction varying from 69% to 98% and orthopyroxene (hypersthene) having a dendritic or sheath-shaped morphology with a skeletal growth of faces. Microprobe study showed that the glass has a microscale heterogeneity expressed in SiO_2 variations over the area. In addition, some portions of the glass correspond to maskelynite. Thus, at the moment of impact event under conditions of rapid melting and cooling, the melt had not managed to homogenize. This scenario is typical for the impact melts and has been reported from many craters.

Formation conditions of the El Gasco pumice. The temperature of pumice formation is estimated at 1780°C based on hercynite composition. The temperature determined from measured and calculated values of refractive index is 1900–2700°C. According to experimental data, ringwoodite of such a composition forms at a pressure of 9 Gpa[6]. During decompression and cooling concentration of magnesium component in olivine increase. The rapid cooling of the melt produces the sheath-shaped and dendritic crystals.

Finding of the ringwoodite proves an impact origin for the El Gasco pumice. The crater itself has not been found to date. It was possibly eroded or overlain by later deposits (special geological works have not been carried out in the region). Pumice of the El Gasco represents ejections of the meteorite crater. We studied an outcrop of analogous pumices in the Pozo de Los Moroz area ~40 km away from El Gasco. However, special structural investigations of olivine have not been undertaken in this area.

Conclusions

The presence of ringwoodite has been proven by electron backscatter diffraction (EBSD) analysis. The parameters of sell for ringwoodite and ferrogortonolite have been determined. The presence of olivine (ferrohortonolite) in pumice in addition to ringwoodite is related to rapid decompression and cooling.

This controls transformation of high density modification (ringwoodite) to a lower density (ferrohortonolite) during crystallization of the melt. The high temperatures and pressures of the melt formation suggest only the impact genesis of the El Gasco pumice, which probably represents ejections of the meteorite crater.

References:

[1].Diaz-Martinez E. Jornal Iberian Geology 2005; 31-1: 65

[2]. Diaz-Martinez., E. VI Congreso geologico de Espana.,Geo-Temas 6(1), 2004 p33-36

[3]. Diaz-Martinez, E.,Sanz-Rubio, E., Fernandez-Martin,C. // Geogaceta, 2001, 30: 47-50

[4]. Glazovskaya L.I., Trubkin N.V. // Doklady Yarth Sciences, Vol 405A,No. 9, 2005, p1317-1320

[5]. Rull.,F., Martinez – Frias J., and Rodriguez- Losada. J. Raman Spectrosc. 2007; 38: 239-244

[6]. Akaogi.,M and Ito.,E.J. Geophys. Res. 1989., 94 (B11), 15671