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Research Article

Mn-WÜSTITE (Fe, Mn)O AS NEW VARIETY OF THE MINERALS FROM CHINARSAY DEPOSIT (TIEN SHAN, UZBEKISTAN)

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ABSTRACT
Unusual association of rare high-temperature minerals of iron – Wüstite (FeO), its new manganese species - (Fe,Mn)O and Suessite - Fe_3Si are determined in the ore-bearing volcanic rocks during the study of the ores mineral composition of gold-pyrite-polymetallic deposit Chinarsay of Khandiza ore field. The presence of 11.2% manganese in Wüstite suggests the possible existence of isomorphic series of FeO – manganosite MnO. The chemical composition of Wüstite and Mn-Wüstite of Chinarsay deposit is presented. Conditions of Wüstite formation are discussed.

Keywords: *Wüstite, Mn-Wüstite, Chemical Composition, Conditions of Formation, Chinarsay Deposit*

INTRODUCTION
Wüstite (FeO) is a mineral form of iron (II) oxide found with meteorites and native iron (Chandy, 1965). Unusual association of rare high-temperature minerals of iron – Wüstite (FeO), its new manganese species - (Fe,Mn)O and Suessite - Fe_3Si are determined in the ore-bearing volcanic rocks in the study of the ores mineral composition of gold-pyrite-polymetallic deposit Chinarsay of Khandiza ore field (Khabibulaeva *et al.,* 2013). Analyzing the few findings of this mineral in the world, it is possible to notice its cosmogenic and terrestrial origin.

Study Area
Chinarsay deposit is located on the slopes of a large volcanic-tectonic structure. Thick sequence of volcanic rocks composed by rhyolite, rhyolite porphyry, tuff lava, litho-vitroclastic tuff, siltstone of C_1 (Ore Deposits of Uzbekistan, 2001). Volcanic rocks are characterized by a large amount of pyroclastics, perlite glassy formations and various textures: massive, fluid-banded, spheruloid, spherical, amygdale. Blistering of lava is conditioned by the abundant separation of fluids. Some amygdales are made from quartz and albite.

MATERIALS AND METHODS
Study of mineral and chemical composition of ores was based on classical mineralogical research methods and modern analytical equipments. Mineral features and chemical composition of Wüstite were analyzed under electron probe X-ray spectrum microanalysis (JXA -8800R "Superprobe") at the laboratory of Institute of Geology and Geophysics Uzbek Academy of Sciences.

RESULTS AND DISCUSSION
Wüstite and Mn-Wüstite grains were met as cubic crystals in association with Suessite and iron carbide in semi-crystallized quartz pearlite with an admixture of 1-2% Al and K. Wüstite and Mn-Wüstite are determined as the lens of dark gray perlite glassy appearance in rhyolite of C_1, hosting gold-pyrite-polymetallic mineralization. Wüstite forms separate crystals of black cubic shape and a grains with size of 40-50 microns. In the crystals there are observed the growth zone, mild signs of strain and cataclastic areas.

In the polished section in reflected light the Wüstite has low reflectance (<20%) close to the magnetite. Internal reflections were not observed. The mineral is isotropic. Hardness of 5.5-6. The chemical composition was determined for grains and cubic crystal, found in association with iron silicide – Suessite (Table 1).

The grain appeared as pure FeO, and the crystal – its manganese variety of formula $(Fe_{0,82}Mn_{0,18})O$. The presence of 11.2% manganese in Wüstite suggests the possible existence of isomorphic series of FeO – manganosite MnO. Manganosite theoretical composition is presented in Table 1. Both minerals are crystallized in the cubic isometrical system (Minerals, 1965). The Mn content in Wüstite was previously noted in tenths of a percent. Analyses of Chinarsay Wüstite allow to separate a new manganese-kind of Wüstite, as well as to call it an intermediate member of the new isomorphous series, Wüstite FeO – manganosite MnO. In published three chemical analyses in manganosite the content of $FeO + Fe_2O_3$ is not exceeding 0.42%.

Manganosite is also rare mineral. Its crystals are in the form of octahedrons. It was found in some high-contact-metasomatic deposits of manganese, formed in a reducing environment: Londgban and Nordmark - in Sweden; Franklin, New Jersey, USA and others (Betekhtin, 1950).

Conditions of Wüstite Formation

Wüstite belong to the high temperature minerals. Experimentally it is obtained at 900^o C. analyzing the few findings of this mineral in the world, it is possible to notice its cosmogenic and terrestrial origin.

Cosmogenic origin is supposed for particle of Wüstite, which were found in cosmic dust in the ice at high altitude glaciers, in the silts at the bottom of the ocean (Minerals, 1965) and in the melting crust of the crater of Sikhote-Alin meteorite. However, in these cases, finding form of iron could be affected by conditions while falling of cosmogenic debris and particles of meteorites into the denser layers of the atmosphere of the Earth.

Wüstite of terrestrial origin is associated with magmatic processes: in hypabyssal near the surface conditions for formation and the early stage of recrystallization of intrusions - granitoids (Chatkal-Kurama Mountains) and volcanic outflow of lava in a submarine environment (Hissar Range) in the Tien Shan, the volcano Mount Vesuvius in the Apennine peninsula.

Table 1: The Chemical Composition of Wüstite and Mn - Wüstite of Chinarsay Deposit

Element	Chinarsay Deposit		Theoretical Content %	
	Wüstite	Mn- Wüstite	WüstiteFeO	ManganositeMnO
Fe	77,73	67,43	77,78	
Mn		11,20		77,46
O	22,27	22,58	22,22	22,54
Total	100,0	101,21	100,0	100,0

Note: The picture and the tests are obtained using electron microprobe “JEOL JXA” 8800R.

Conclusion

Finding of new manganese species of Wüstite suggests the possibility of isomorphism of Fe^{+2} and Mn^{+2} in the conditions of high temperature and oxygen access at the volcanic and near-surface magmatic processes, accompanied by a rapid drop in temperature (T^oC) and pressure (P).

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