SHOCK INDUCED INTERACTION BETWEEN METAL IRON AND SILICATES. D.D.Badjukov(1), T.L.Petrova(2) - (1) Vernadsky Institite of Geochemistry and Analytical Chemistry, Kosygin Str. 19, Moscow, 117975,; (2) Institute of Lithosphere, Staromonetny per., Moscow, USSR

Some chemical reactions occuring during high-velocity meteorite impacts may have played important role in the accretion of terrestrial planets. The reactions occuring at high PT conditions could lead to modification of chemical compositions of primary minerals in a target and in a projectile. A metal - silicate interaction, where Si is an oxidizer, belongs to reactions of this type. A possibility of such reaction between a kamacite projectile and a quartz target has been demonstrated recently by experiments [1,2].Similar metal-silicate reactions may also occur at the mantle/core boundary being responsible for the density deficit of the Earth's core due to admixture of silicon to the core metal [3].The purpose of the study is to investigate interactions of metal iron with some silicate minerals by shock loading.

Studied samples of albite (Ab), jadeite (Jad), zircon (Zyr), and enstatite (En) were shocked in cylindrical steel containers surrounded by high explosive. Pre-shock porosity of <0.25 mm powder samples pressed in the containers was about 25% for Ab and Jad and 15% for Zyr and En. Shock wave patterns in the samples are very complicated, and, hence, PT parametres can be only estimated very roughly as about of 100 to 150 GPa with the peak temperature about a few thousands K. Chemical compositions of the samples are given in Table. The containers were made from steel containing Mn (0.5wt.%), S (0.05%), C (0.2%), and Si (0.15%).

Spheroidal metal inclusions were found in the recovered melted samples. The inclusions tend to be concentrated in the glassy matrix towards a center and a bottom of the cylinder samples. The metal spheroids were picked up from a slightly crushed silicate material, and, after cleaning and polishing, were investigated by microprobe technique. Fig. illustrates Fe - Si concentrations in the individual metal inclusions. All analyses were normalised to 100% and the deviation of the dots from the straight line is due to a presence of other components in the spherules. Highest Si contents (up to 13.8 wt%) were measured in the spherules resulted from the experiment with Zyr. In two cases the spherules contain also P (0.1 and 0.8%). The spherules from Ab are lower in Si (up to 7.4%) and enriched in P (up to 12.1%). A phosphide pase with up to 19.7% was identified in one case.Smaller Si concentrations were found in the metal spherules from En and Jad (up to 1.4% and 2.4% respectively). Only 60% and 25% of the metal spherules from Jad and En, respectively, contain Si. Admixture of Cr up to 0.7% (average 0.2%) is typical for the spherules from En.

The metal particles may enter into silicate matrix by two ways: 1)spallation of metal pieces from container walls during propagation of shock wave, and 2)contamination of the samples during their pressing into the container. Although there are some uncertainties in origin of the metal spherules, we believe that a composition of their initial material is the same as the composition of the container metal. The enrichment of the spherules in Si occures in all shock experiments. The carbon content (0.2%) in the steel container is too low to explain the observed Si content in the metal spherules, because only an 0.4% Si concentration could be caused by this carbon reduction. The most plausible process of the Si reduction is a red-ox reaction between silicates and Fe metal which should be similar to the above-mentioned reaction of silica with iron [1] where the reduction of Si is accompanied by oxidizing of Fe. Behavior of P at the shock condition is probably of the same nature as that of Si. High Cr content in the metal spherules derived in the En experiment could be due to a presence of chromite inclusions in enstatite and their interaction with the metal phase.

Thus, the preliminary investigation shows that there is an interaction between silicates and metal iron under shock loading which leads to reduction of Si. This interaction should be taken into account for reconstruction of chemical processes, which took place during accretion of planetary bodies.

REFERENCES:[1] Badjukov D.D., (1990), LPI XXI, p.36; [2] Yakovlev O.I. et al., (1991), Geochimia (in Russian, in press); [3] Kuskov O.L. (1975), Geochimya, N8,p.1137 (in Russian)

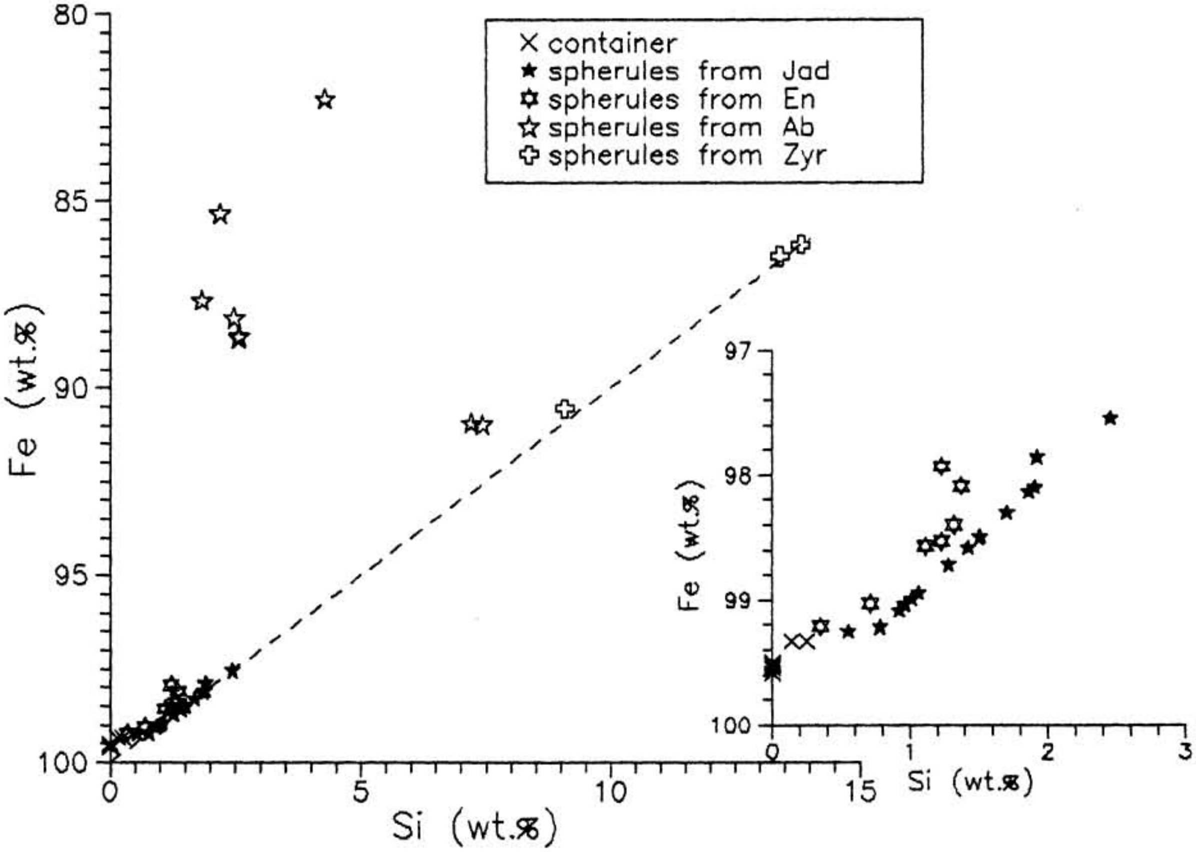

FIG. Fe vs Si plot showing the compositional range of the spherules and containers steel. Analyses of the spherules without Si were excluded.

Table. Chemical composition of shocked minerals.

Sample	Ab	Jad	En	Zyr
SiO_2	69.04	58.62	56.93	32.30
TiO_2	.03	.11	.06	.17
Al_2O_3	19.56	24.35	1.27	.05
MnO	.01	.01	.20	--
MgO	--	.65	32.77	--
FeO	.07	.62	7.04	.37
Cr_2O_3	--	.01	.27	--
CaO	.16	1.51	1.86	--
Na_2O	11.49	14.93	--	--
K_2O	.26	.20	.16	--
P_2O_5	.20	.05	.05	.12
ZrO_2	--	--	--	66.09
Total	100.82	101.06	100.61	99.10