SHOCK METAMORPHISM OF ROCK-FORMING MINERALS UNDER STEP-LIKE SHOCK COMPRESSION OF SOUTHERN URAL'S AMPHIBOLITE. I. V. Belyatinskaya[1], V. I. Fel'dman[1], V. V. Milyavskiy[2], D. M. Zhernokletov[2], T. I. Borodina[2], [1]Department of Petrology, Moscow State University, Moscow 119899, Russia, e-mail belyatirina@yandex.ru, [2]Institute for High Energy Densities RAS, Moscow, Russia.

The shock-metamorphic transformations of rock-forming minerals (amphibole, plagioclase, clinopyroxene, scapolite) of streaky amphibolite PR_{1-2} (Southern Ural, Russia) have been studied with the use of recovery assemblies of planar geometry. The experimental procedure was described in ref. [1, 2]. The maximal shock pressures in the samples were attained upon a few reverberations of the waves between the walls of the recovery ampoule (step-like shock compression) and were equal to 26, 36 and 52 GPa. Pristine and recovered samples were examined by the methods of optical and scanning electron microscopy (SEM), microprobe analysis, and X-ray phase analysis (XPA).

In the recovered samples mechanical (fissuring, amorphization) and chemical (bringing and carrying-out of different compounds) transformations of minerals were observed.

Plagioclase (Pl). The original Pl has rather sodium composition (An_{28-33}). The strongest transformations (both mechanical and chemical) were observed in plagioclase. At 26 GPa plagioclase is heavily cracked and at 36 GPa almost all the plagioclase (up to 90%) becomes amorphous (Fig. 1).

Concurrently crystallite size in plagioclase decreases to 15 nm (>100 nm in the pristine rocks) at 36 GPa. At 52 GPa plagioclase is amorphous overall. Besides, at 36 GPa Na is carried out from amorphous plagioclase strongly, but cristilline relicts of plagioclase don't reveal carrying out of any elements (Fig. 2). At 52 GPa Ca begins to be carried out equally with Na.

Amphibole (Cam). The pristine amphibole belongs to the group of calcic monoclinic amphiboles (according to microprobe analysis it is magnesiohastingsite, Fig. 3). Amphibole is transformed weaker than plagioclase. At 36 GPa amphibole is heavily cracked (maximum of amphibole fissuring is observed) but none becomes amorphous (Fig. 4). At 52 GPa it becomes partially amorphous (up to 50%, Fig. 4). For amphibole carrying out of Fe and bringing of Mg is registered, especially for heavily fissured amphibole.

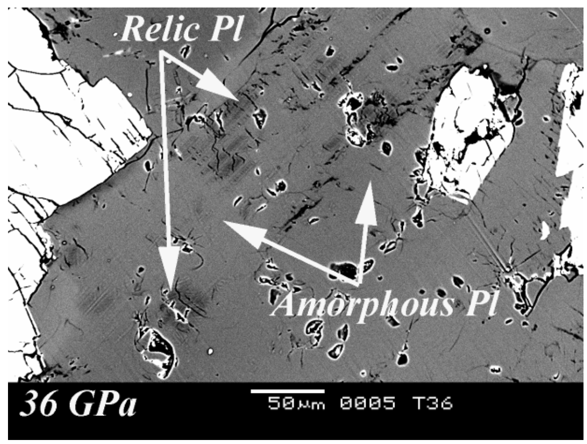

Fig. 1. Plagioalcse from the sample loaded up to 36 GPa is almost completely (90%) amorphous. Cristalline plagioclase is observed only as rare relics.

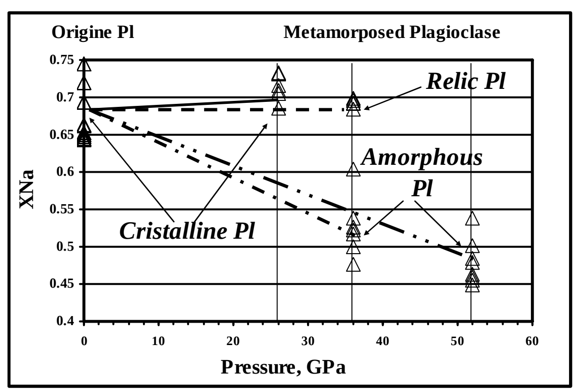

Fig. 2. Na is being carried out from amorphous plagioclase at 36 and 52 GPa, the composition of crystalline plagioclase doesn't change at 26 and 36 GPa in comparison with the original plagioclase.

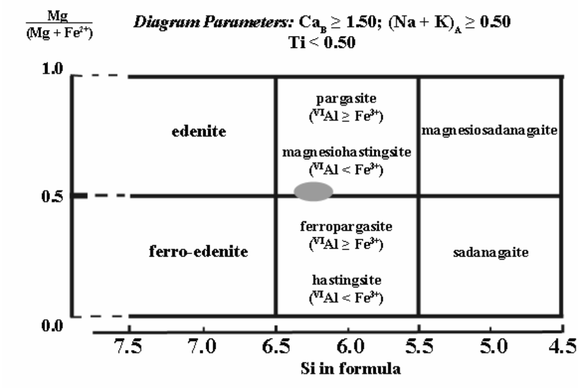

Fig. 3. Composition of the pristine amphibole (gray area) in comparison with the systematics [3].

Clinopyroxene (Cpx) and scapolite (Scp). The original clynopyroxene belongs to calcic monoclinic pyroxenes (group of diopside–hedenbergite). The pristine scapolite belongs to Mizzonit (calcic scapolite). Clinopyroxene and scapolite reveal the weakest transformation among all rock-forming minerals. These minerals don't become amorphous and undergo no chemical transformations in all explored pressure range.

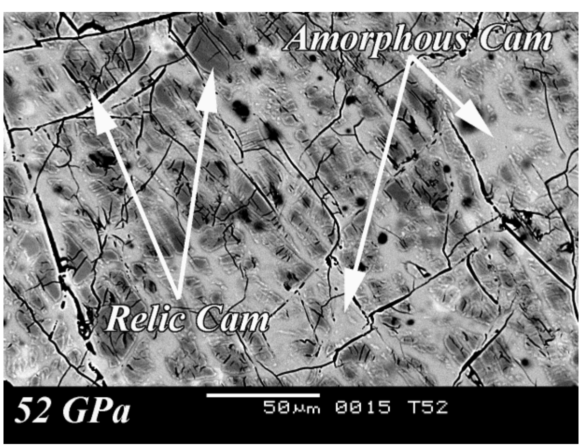

Fig. 2. Amphibole from the sample loaded up to 52 GPa is amorphous up to 50%.

Conclusions. The observed consistency of shock-induced changes of minerals under step-like shock compression corresponds to shock-thermal decomposition row [4]: layer – band – chain silicates and aluminum silicate – silicates with single Si–O tetrahedrons.

Shock-metamorphic transformations of rock-forming minerals of the amphibolite were studied earlier with the use of spherical converging shock waves [5]. Comparing shock-metamorphism of minerals in these two types of shock experiments we reveal significant differences in these changes. Under the step-like shock compression amphibole doesn't undergo shock-thermal decomposition with forming of andesine, amphibole and metallic mineral aggregate even at 52 GPa. Under the spherical shock compression this phenomenon is observed at 40 GPa already. The same is observed for clinopyroxene – under the spherical shock compression in the range of 40–60 GPa it transforms to the aggregate of plagioclase, amphibole, clinopyroxene and magnetite. For scapolite under the spherical shock compression in the same pressure rage bringing of Si, Fe, K and carrying out of Al and Na is observed. The possible reason for these differences is that under plane step-like shock compression a lower shock temperature is generated (as compared with the spherical converging shock waves).

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