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Origin of variolitic lavas: Evidence for variolites in axial part of the Mid-Atlantic Ridge, 6oN

Evgenii Sharkov, Irina Krssivskaya, and Alexei Chistyakov

Institute of Geology of Ore Deposits, Petrograpgy, Mineralogy and Geochemistry RAS, Petrology, Moscow, Russian Federation (sharkov@igem.ru)

Fragment of variolitic lavas was dredged in axial part of the MAR at 6oN during 10th cruise of R/V "Akademik Ioffe" (2001-2002). It is rock where rounded globules of andesite (icelandite) with light trachyandesite rims are enclosed in high-Ti picrobasalt matrix. The sample can be subdivided in two different structural parts, or "layers". One of them densely saturated by globules, which closely adjoin to each other, merge in clumpy congregations with small quantity of matrix material in interstices. In the other part of the sample matrix predominates. Isolated, sometimes sticked together globules "swim" in the matrix and their quantity and size quickly decrease to the sample edge, where only small rare globules occur. Boundary between both parts, even if irregular due to rounded shape of closed globules, nevertheless is well-defined and has small bays of the matrix material. So, globules were moved in picrobasalt melt and floated up to the surface of the lava flow.

It is shown that formation of the leucocratic rims was evidently linked with thermal diffusion phenomenon (Soret principle) in cooling heterogeneous melt. According to this principle, components in solutions and melts, placed in thermal gradient, are redistributed for leveling of internal energy in that way, when light elements migrate to hot parts and heavy ones to cold. Experimental studies of thermal diffusion in samples of MORB showed enlarge of Si, Al, Na and K concentration to side of hot area of melt and Fe, Mg, Ca, etc. to cold one; resulting melts were Qtz-normative andesites and Ne-normative picrite (Walker, DeLong, 1982). The same picture we saw in our sample: enrichment of external zone of globules by Si, Al, and, especially, by high-mobile Na, which diffusion rate in silicate melts in some order higher than speed of remaining elements (Watson, 1982; Borisov, 2008). Simultaneously, this zone impoverished by Fe, Ca and Mg, which were concentrated in rear of rims, forming internal zoning of globules with careless boundaries. Effect of thermal diffusion in more important for Fe; as a result #mg in trachyandesite rims higher than in andesite cores of globules.

It suggests that origin of variolites was linked with intersection by ascended column of picrobasaltic magma of existed at that time in crust above small shallow magmatic chamber with residual melt of andesite (icelandite) in composition, which was involved in general upwards current. Because ascending of magmas in axial part of the MAR was whirl (Sharkov et al., 2008), alien melt was dispersed on small drops, but, however, had not time to dissolved in host picrite melt. Formation of proper variolites was occurred in process of moving and cooling of such heterogeneous lava on oceanic floor.. From this follows that axial parts of low-spreading ridges have very complicate structure, where different melts can coexist. There are no any evidence of liquid immiscibility the variolite origin

The same petrological features are typical for classic Paleoproterozoic variolites of the Yal-Guba, Onega Lake, Karelia, which are also pillow-lavas. They were firstly described by F.Yu. Levinson-Lessing in 1920th. We conclude that variolite formation are linked with complex magmatic systems where small shallow magma chambers with evolved melt were intersected by streams of new magma portions from deep-seated source. Indispensable condition for variolites is contrasting composition of the magmas which allow to clearly see this phenomenon.