THERMODINAMIC CONDITIONS OF EARLY SERPENTINE FORMAYION WITH HYDROCARBONIC FLUIDS ASSOTIATION

Yurkova R.M., Voronin B.I. (IPNG RAN)
bivrmyrz@mtu-net.ru; Fax: (495) 135-54- 65; Phone: (495) 135-53-93; (495) 405-11-21

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Research was conducted in the northwest active continental margin of the Pacific: Sakhalin, Kamchatka, Koriakskiy range, Karaginy Island, Shirshova range in the Bering Sea. Different types of ultrabasite serpentinization were studied: early pseudomorphic and multistage hydrothermal metasomatic, superimposed types. Stages and conditions of serpentinization and subsequent hydrothermal metasomatic transformation of ultrabasites in various structural tectonic positions were traced. Initial generations of serpentinite of early non-magnetitic serpenitization were studied. They are represented in apoharzburgite serpentinite common in the central non-dislocated parts of dunite-harzburgite massif of an area of 42 km^2, which is considered to be the most ancient mantle complex of ophiolite.

In the process of early loop-shaped serpentinization, antigorite serpentine with elementary cell parameter α = 35.5Å and a natural melt of iron and nickel of taenite composition in the form of smallest inclusions (2.5 μm) in antigorite were formed at the expense of olivine. Very fine texture of antigorite zone and direct replacement of olivine by antigorite, then the antigorite in the hollow of the loop by coarse laminated lizardite and the latter in its turn by linear laminated lizardite of the second generation suggests early formation of antigorite directly by olivine. The formation of antigorite on conditions of mantle serpentinization at depths of 40–50 km (up to 100 km) by reaction $2Mg_2SiO_4+Mg_2Si_2O_6+4CO+12H_2 \rightarrow Mg_6Si_4O_{10}(OH)_8+4CH_4$ is supported by experimental, thermodynamic (T=450–600°C, P = 13–16 kbar) and balance calculations [1].

Table. Contents of hydrogen, methane mmol/kg and Fe^{2+}, Fe^{3+} in serpentine and serpentinite

Serpentine and Serpentinite	Mantle		Crust-pseudomorphous				Hydrothermal-metasomatic					Oceanic	
	Olv	251a	251в	251c	251d	251	1335	457	626	446	284	1999	2002
H_2	800	230	150	140	0.0	130	90	100	60	500	10	-	16
CH_4	-	30	15	20	15	10	10	20	10	10	0.0	0.3-0.6	2,5
Fe^{2+}	0.19	0.22	0.00	0.00	0.44	-	0.07	0.36	0.00	0.22	0.24	-	-
Fe^{3+}	0.00	0.14	0.44	0.47	0.18	-	0.37	0.08	0.75	0.22	0.25	-	-

Olv – olivine; 251a –antigorite; 251в – lizardite early generation; 251c - lizardite late generation; 251d – bastite; 251, 1335,457, 626, 284 – serpentinite wholly; 446 – chrysolite and lizardite in protrusion with sheet dike complex; 1999 - oceanic apoperidotite serpetinite [3], 2002 – the Rainbow hydrothermal field [2].

The highest content of H_2, CH_4 in harzburgite serpentinite (230 mmole/kg of rock) is characteristic of apoolivine antigorite of early generation (table). Hydrogen high content in harzburgite (800 mmole/kg of rock) is associated with olivine. Hydrogen amount decreases with lizardite replacing antigorite (150 mmole/kg rock) and in lizardite of breakings through forming large loops with long-lived ways of fluid migration in the middle (140 mmole/kg rock) and reduces to zero in bastite lizardite. The association of antigorite containing iron for the major part bivalent with iron nickel was formed in reduction conditions. Carbon oxide suggests reduction conditions of the environment where serpentinization processes went on. In these conditions hydrogen formation is impossible at the expense of a part of bivalent iron oxidation, which a number of researchers predict. [2]. In our experiments, it is supported by a lacking correlation between FeO content in samples (improved from data of micro sounding analysis with the use of Mössbauer spectroscopy) and the amount of hydrogen emission. These data and mainly coincidence of H_2 and CH_4 emission in the process of heating samples allow us to assume that predominant part of hydrogen cannot be attributed to autooxidation of ions Fe^{2+} with serpentinite heating and was originally contained in the minerals under investigation. The rise and transformation of deep hydrocarbon fluids in the regions under investigation are associated with the formation of ophiolite diapir in the transition zone primitive island arc – trench above Benioff zone. Besides, researchers corroborate diapir intrusions of serpentinous ultrabasites in the frontal areas of island arcs above Benioff zone in the Japan and Mariana island arc systems [4,5]. An ophiolite diapir is exposed on the surface in Schmidt Peninsula (Sakhalin) The continuation of the diapir or the column of diapirs in the Okhotsk Sea water area is established from zones of intense (2000 gamma) positive magnetic anomalies and gravity anomalies in Bouguer's reduction (88 mgk). The amount of methane of the order of $4 \cdot 10^{13}$ tons is taken out with the diapir. Judging from the data of fluid dynamics studies up to now the flow and discharge of deep hydrocarbon fluids go on in gravitation convection and compression conditions and with ophiolite diapir the rise of which has not been fully completed in the Sea of Okhotsk. These conditions provided the formation of gas hydrate and gas deposits in the Sea of Okhotsk as a result of migration and transformation of hydrocarbon fluids on shear faults feathering the ophiolite diapir.

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