# DOES DENSE HYDROUS MAGNESIUM SILICATES (DHMS PHASES) EXIST IN A MANTLE?

**Khisina N.R.** (GEOKHI RAS)
*khisina@geokhi.ru*

In the light of modern concept of "wet" mantle the question of which minerals can serve as $H_2O$ storage in a mantle arises. The currently available data allow suggest two main groups of such minerals.

***High-pressure magnesium silicates (DHMS phases)***

During last 15-20 years Dense Hydrous Magnesium Silicates (DHMS phases) have been synthesized under high *P* – high *T* conditions [1]. They have been named as alphabet phases (table 1) and are considered as candidates for water storage in a mantle [2]. However DHMS as own minerals are not found in natural material (with exception of humite seria). On the other hand, recently some representatives of DHMS were observed as nanoinclusions in olivines from mantle nodules in kimberlites [3,4].

***Nominally anhydrous minerals***

IR spectra of nominally anhydrous silicates (olivine, pyroxene, garnet) detect $H_2O$ in amount of several ten - several hundred ppm [5]. Olivine being a main mineral in a mantle can be considered in some sense as a reservoir of $H_2O$ in a mantle [2]. Transmission Electron Microscopy study of mantle olivines give an evidence of occurrence of $H_2O$ as both *extrinsic* (nanoinclusions of DHMS) and *intrinsic* (structure $OH^-$ defects) [3]. DHMS nanoinclusions consist of either 10Å-Phase, or hydrous olivine, or humite.

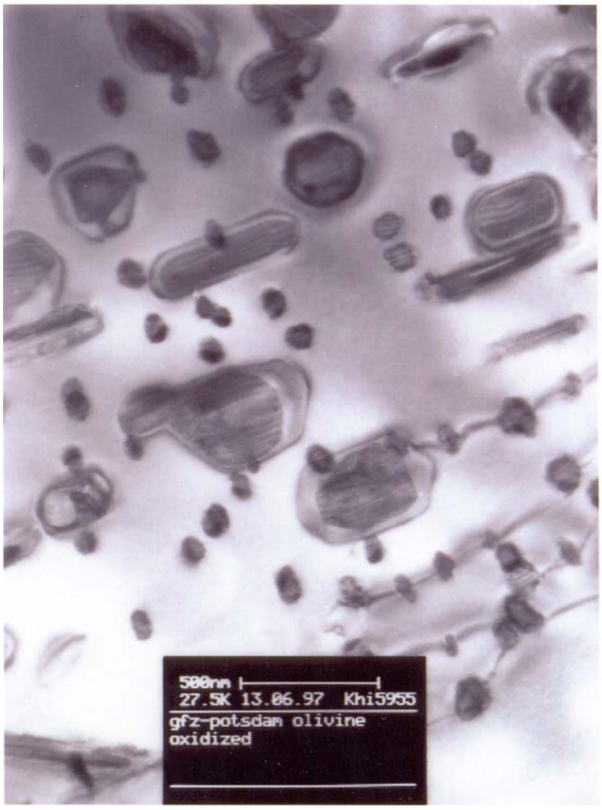


**Fig.1.** Nanoinclusions of DHMS in olivine from mantle nodule (kimberlite pipe "Udachnaya")

*P-T*-conditions of DHMS synthesis can be related to different depths of a mantle and the available data allow conclude: (1) DHMS can be classified into several groups. *P*-conditions of the 10Å-Phase and Phase A correspond to the pressure range of upper mantle, Shy-B and Hy-β - to the pressure range of transition zone; E and B can be attributed to the lowest parts of upper mantle as well as to upper parts of transition zone. Phase D can be attributed to the lowest parts of transition zone as well as to upper parts of lower mantle. (2) Any vertical, either up- or down- shifting in a mantle should be accompanied by dehydration of DHMS. Experimental data show that Shy-B should be dehydrated producing MgO and $SiO_2$ (stishovite) at the boundary between transition zone and lower mantle; serpentine should be dehydrated with Phase A formation in cold subduction zones; 10Å-Phase should be dehydrated to talc under decompression.

Experimental observations of DHMS nanoinclusions in mantle olivines support the hypothesis of DHMS occurrence in a mantle. The fact of the absence of DHMS as own minerals in natural material can be explained by two reasons. (1) There is no geological material coming from transition zone and lower mantle. (2) Any lifting of mantle material should be accompanied by subsequent dehydration of DHMS, thus DHMS “disappear” during transportation to the surface.

**Table 1.** DHMS phases: P-T conditions of synthesis and density (by [1])

| Phase | Formula | *P*, kbar | *T*, $^0$C | $\rho$, g/см$^3$ |
|---|---|---|---|---|
| Phase A | $Mg_7Si_2O_8(OH)_6$ | 55 - 160 | 750 – 1170 | 2.96 |
| Phase B | Mg24$Si_2$(IV)Si6O38$(OH)_4$ | 100 - 150 | 800 - 1200 | 3.37 |
| Shy-B | $Mg_{10}Si(IV)Si_2O_{14}(OH)_4$ | 200 | 1400 | 3.30 |
| Phase D | $Mg_{1.11}Si_{1.89}H_{2.22}O_6$ | 200 | 1200 | 3.5 |
| Phase E | $Mg_{2.27}Si_{1.26}H_{2.4}O_6$ | >130 | 1000 | 2.88 |
| Phase “D” Liu | $MgSiO_4H_2$ | 220 | 1200 | |
| Hy-β | $Mg_{2-x}SiO_4H_{2x}$ | 155 | 1300 | 3.31 |
| 10Å-phase | $Mg_3Si_4O_{14}H_6$ | 30-60 | 375-700 | 2.65 |
| Humite group | $n[Mg_2SiO_4][Mg(OH)_2]$ | 30-120 | 940-1170 | 3.06-3.15 |

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