# ENTHALPIES OF FORMATION OF MINERALS OF SERPENTINE GROUP

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The minerals of magnesium serpentine group of composition $Mg_3Si_2O_5(OH)_4$: natural scale antigorite (Saronovskoe deposit, N.-W. Ural), chrysotile-asbestos from serpentinizated ultrabasites (E. Sayani) and synthesized under hydrothermal conditions lizardite were studied. The diagnostic investigations were performed by electron microprobe and thermal analyses, X-ray diffraction and IR-spectroscopy. For thermochemical study of serpentines the high-temperature heat-flux Tian-Calvet microcalorimeter was used. The enthalpies of formation were determined by "transposed temperature drop solution calorimetry" method. A samples of 1.5-10 ($\pm 2 \times 10^{-3}$) mg were thermostated at room temperature and were thrown down into the calorimeter with a melt $2PbO{\cdot}B_2O_3$ as a solvent at $T$=973 K. The heat measured contained two contributions: the heat content of the samples and the enthalpy of solution at $T$=973 K - [$H^0$(973 K)-$H^0$(298.15 K)+$\Delta_{sol}H^0$(973 K)]. The calorimeter was calibrated in the same manner by using a platinum reference sample with known enthalpy increments [1]. Using experimental and needed thermochemical data for constituent oxides the standard enthalpies of formation of minerals studied were calculated (table). The values of $\Delta_f H^o{}_{el}$(298.15 K) obtained are in a good agreement within experimental errors. Differences between magnesium serpentines are associated with some disproportions between octahedral and tetrahedral nets in structure, which lead to formation of different structural lays - planar (lizardite), cylindrical (chrysotile) и curved modulated (antigorite). Our results show minor energetic distinctions between these three structural types.

**Table**

Thermochemical data for minerals studied and constituent oxides (kJ/mol)

| Substance | $H^o$(973 K)-$H^o$(298.15 K)+ $\Delta_{sol}H^o$(973 K) | -$\Delta_f H^o{}_{ox}$(298.15 K) | -$\Delta_f H^o{}_{el}$(298.15 K) |
|---|---|---|---|
| MgO (s) | 36.38±0.59 [a] | | 601.6±0.3 [1] |
| $SiO_2$ (s) | 39.43±0.21 [b] | | 910.7±1.0 [1] |
| $H_2O$ (l) | 40.9±2.5 [c] | | 285.8±0.1 [1] |
| Antigirite | 445.1±10.6 (8) [d] | 170±12 | 4368±12 |
| Chrysotile | 425.7±16.5 (6) [d] | 156±17 | 4353±17 |
| Lizardite | 425.5±10.2 (4) [d] | 156±12 | 4353±12 |

[a, b] – calculated using reference data on [$H^o(T)$-$H^o$(298.15 K)] [1] and experimental data on $\Delta_{sol}H^o$(973 K): [a] – [2], [b] – [3]; [c] – estimated in [4]; [d] - errors are expressed by interval for P=95%, in brackets the number of determinations is given

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