ESTIMATION OF INFLUENCE OF HEAVY LIQUIDS ON THE ELEMENTAL COMPOSITION OF THE CHONDRITE MINERAL SEPARATES BY NEUTRON ACTIVATION ANALYSIS

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Introduction. Thermal and shock events on the parent bodies of chondrites as well as processes that operated during condensation, accretion and agglomeration of solids in the solar nebula have caused a significant effect on the chemical-petrological characteristics of the meteorites of this class. Moreover, the peculiarities of the major mineral chemical compositions are one of the principal parameter in the classification scheme of chondrites reflecting the level of their thermal metamorphism. This process also leads to the redistribution of trace elements between the mineral constituents of chondrites. However, the information on the behaviour of these elements during thermal metamorphism is rather scarce due to the difficulty to select out the fine-grained crystal of individual minerals by handpicking under microscope, especially μm-sized accessory ones. To solve this problem the technique of mineral separation by centrifuging the crashed nonmagnetic fraction of a chondrite in the heavy liquids of different density has been developed [1,2]. This procedure was also used for receiving the mineral separates of Adhi Kot EH4 and Pillistfer EL6 enstatite chondrites [3]. The separation has been carried out on a T-23 centrifuge in 4000-5000 cpm mode during two hours in Clerichi (a mixture of $Tl(CH_2OOTl)_2$ and $Tl(HCOTl)$, ρ=4.18 g/cm^3) and M-45 (a mixture of BaI_2 and CdI_2, ρ=2,93 g/cm^3) heavy liquids which density has been changed by adding water. As a result the following mineral fractions have separated out from above mentioned chondrites: enstatite. cristobalite, niningerite and troilite (Ahdi Kot), and enstatite, troilite and plagioclase (Pillistfer) The purity of the mineral phases was controlled by microscopic examination and by X-ray diffraction analysis.

However, while the following determination of elemental composition of minerals using any method, especially such highly sensitive one like INAA, it is necessary to take into consideration the possible contamination of the samples under investigation with the trace amounts of heavy liquids.

In order to find the criteria for quantitative evaluation of the heavy liquid trace impurities in the analyzed mineral separates an elemental composition of Clerichi and M-45 solutions has been determined by INAA.

Experiment. The solution aliquots (0,1 ml) were brought on silica gel substrate and along with KH and TB standard reference rocks, standard solutions of metals and sample of silica gel (for background correction) were irradiated for 20 hours at a neutron flux of 10^{13} n/cm^2·c. Induced activity of samples was counted at different cooling times.

Owing to occasional nature of mineral contamination a special attention was paid to the search of reliable criteria of heavy liquids presence in the samples as well as on the obtaining of the liquid amounts independent parameters allowing to insert necessary correction for liquid admixture in the analyzed mineral phases.

Results. The most prominent gamma-lines of the radionuclides of Ba, Cd, I and Tl) liquid basic elements are in the 300-550 keV range (see Fig.). After subtracting the background activity of silica gel substrate, the gamma-lines belonging to radionuclides of Ba, As, Sb, Br, Cr, Zn (Clerichi) and Cr, Zn, U (M-45) are also visible in spectra. The content of these admixture elements in solutions varies between 0,3 μg/g (Br, Sb) and 30-50 μg/g (Zn, Ba). The activity of other trace elements (such as Na, K, Sc, Se. REE. Hf. Ni, Co, Fe, Ir, Au and so on), usually determined in chondritic phases by INAA, is at the same level as the background activity of silica gel. The intensity of the gamma-lines Tl, I, Cd and Ba radionuclides is ten times greater than that of admixture elements. Thus, the contamination of the mineral separates by trace amounts of heavy liquids can be readily detected on the presence of ^{202}Tl (Clerihci) and/or ^{11}5Cd (M-45) photopeaks in gamma-spectra of samples. The contents of Tl and Cd in the meteoritic minerals are lower than their detection limit by INAA. The most essential problem is the correction for possible contribution of Ba from M-45 in its content in the mineral phases. For the quantitative assessement of the correction factors, needed in this case, the ratio of ^{115}Cd/^{131}Ba or ^{126}I/^{131}Ba photopeak areas can be used. The value of these ratios (taking into account the

difference of radionuclide half-lives) is constant and does depend on the amount of M-45 solution in the mineral separates. As follows from nuclear characteristics of elements, the most appropriate pair of radioniclides is ^{131}Ba and ^{126}I having similar half-lives, 13.3 d and 11.8 d, respectively. The relationship between activity of these radionuclides is constant and independent from both irradiation and cooling times. However, due to low induced activity of ^{126}I, the correction factor for Ba from M-45 can be more precisely calculated from ^{115}Cd/^{131}Ba photopeak ratios, but accounting for differences in half-lives of this radionuclides.

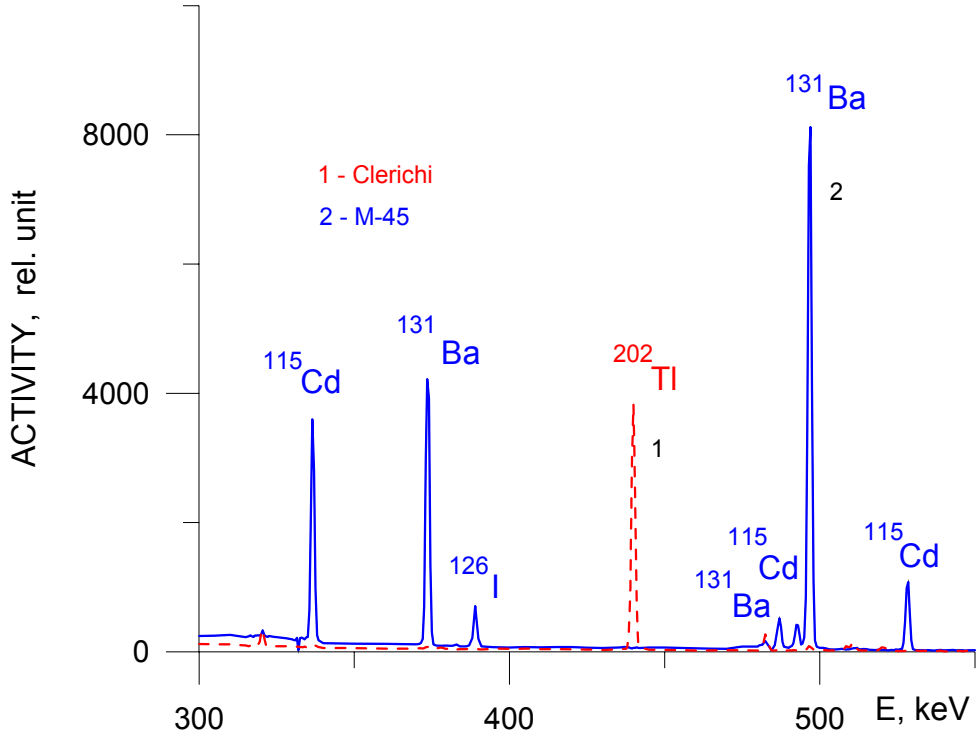

Fig. Gamma-spectra of heavy liquids in the 300 – 500 keV range.

Out of all analyzed minerals of enstatite chondrites only the plagioclase fraction of Pillistfer chondrite was contaminated with M-45 solution. In this specific case correction for background contribution of Ba from solution has amounted approximately to 70%.

Conclusion. The presence of the heavy liquid trace impurities in the chondritic minerals is reliable identified according to availability in their spectra representative of every liquids gamma-lines, namely, 438.5 keV for Clerichi and 336,3 & 388.6 keV for M-45. If it necessary, correction factors for contamination of the mineral samples by heavy liquids can be calculated from experimentally derived set ratios between the photopeaks of liquid radionuclides.

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