DISTRIBUTION OF Ni, Co, Au, AND Ir AMONG CHONDRULES FROM CARBONACEOUS, ORDINARY AND ENSTATITE CHONDRITES

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Siderophile element contents measured currently in chondrules can be explained by the influence of two major processes: the metal-silicate fractionation in a solar nebula (siderophile element contents in chondrules of chondrites of different chemical groups) and the secondary processes in the parent bodies of chondrites (content of siderophiles in chondrules of chondrites of different petrologic types). To estimate the influence of primary and secondary (aqueous and thermal) processes on chondrule elemental compositions, the Ni, Co, Au, and Ir contents and their distribution in chondrules of chondrites of both different petrologic types and groups are considered. The frequency histograms of this element distributions among chondrules from carbonaceous and enstatite chondrites are presented in Fig. 1[1-5] and in chondrules from ordinary chondrites in fig. 2 [6-11].

Results. A comparison of the of Ni, Co, Au, and Ir mean contents in chondrules of the CM2, CR2, CO3 and CV3 chondrites [1-4, 12,13] has shown that chondrules of the CM2 chondrites are very highly depleted in these elements respect to both chondrite matrices and chondrules from the other groups of carbonaceous chondrites. Moreover, these chondrules are also in the same degree depleted in Fe and Na [12,13]. The depletion of the CM2 chondrite chondrules, which contain a appreciable amount of the secondary aqueous minerals [14], in various elements with different geochemical properties may be attributed to an action of the aqueous processes on the parent body of chondrites.

As follows from the fig. 1 and from the earlier data [13] it is possible the existence of two groups of chondrules with a different content of the siderophile elements in the CR2 chondrites. These distinctions may be primary due to the fact that these chondrules are not highly depleted in Na, typical for chondrules altered by aqueous processes. It can be noted, that only in the chondrules of CR2 chondrites no fractionation of siderophile elements can be observed, whereas chondrules in both group of C3 chondrites are enriched in Ir relative to more volatile Ni, Co and Au. As a whole, siderophile element distribution among chondrules of the CR2, CO3 and CV3 carbonaceous chondrites does not depend on their petrologic type. Therefore, weak thermal metamorphism that experienced the carbonaceous chondrites does not produce a noticeable redistribution of the siderophile elements between their chondrules.

Chondrules of the Qingzhen EH3 chondrite that has been formed under highly reduced conditions are characterized by low and rather homogeneous content of siderophile elements (fig. 1) and also of Fe [5]. The frequency histograms for Ni, Co, Au, and Ir of this unequilibrated EH3 chondrite differ greatly from the appropriate histograms for chondrules of the unequilibrated carbonaceous and ordinary chondrites and are very similar to those for equilibrated ordinary chondrites (fig. 2). These data are in agreement with the earlier conclusion [5], that Qingzhen chondrite has experienced more intense metamorphism than the LL3.0-1-type of unequilibrated ordinary chondrites.

A more intense thermal metamorphism of the type-4,5 ordinary chondrites leads to essential redistribution of siderophile elements between chondrules in these chondrites (fig. 2). It is possible to note that a behavior of Ni, Co, Au, and Ir during metamorphism greatly differs from the behavior of Fe. With increasing degree of metamorphism a number of chondrules with both low and high Fe contents decrease. Contrary to Fe, in a sequence from unequilibrated to equilibrated chondrites there is a clearly expressed tendency to increase a number of chondrules with low contents of Ni, Co, Au, and Ir. The Co is the most sensitive element to thermal metamorphism. In a lesser degree the metamorphism has an influence on the Au and Ni contents in chondrules.

Conclusions. It has been found that secondary aqueous and thermal processes in the parent body of chondrites had an essential influence on chemical composition of chondrules due to redistribution of elements between chondrules and matrix as well as between chondrules within individual chondrites. These processes are responsible for a depletion of chondrules in the siderophile elements that is observed in the CM carbonaceous and equilibrated ordinary chondrites. A primary composition could only retain the chondrules of weakly thermally metamorphosed chondrites that were not altered by aqueous processes.

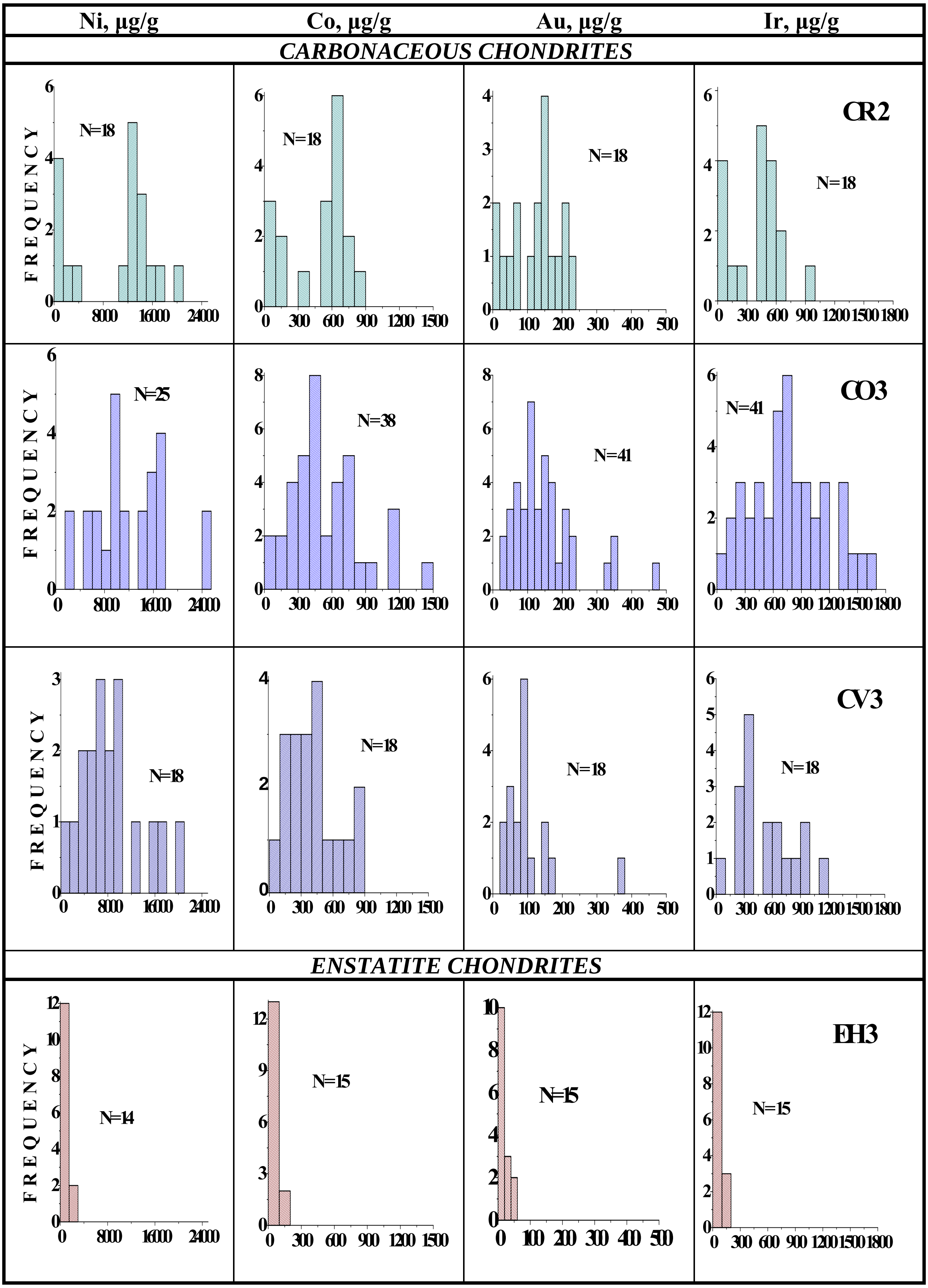

Fig.1. Frequency histograms for Ni Co, Au and Ir distribution in chondrules of carbonaceous chondrites (**CR2** - Renazzo [1]; **CO3** - Kainsaz [2], Ornans [3], **CV3 -** Allende [4] and enstatite chondrite **EH3** – Qingzhen [5];.

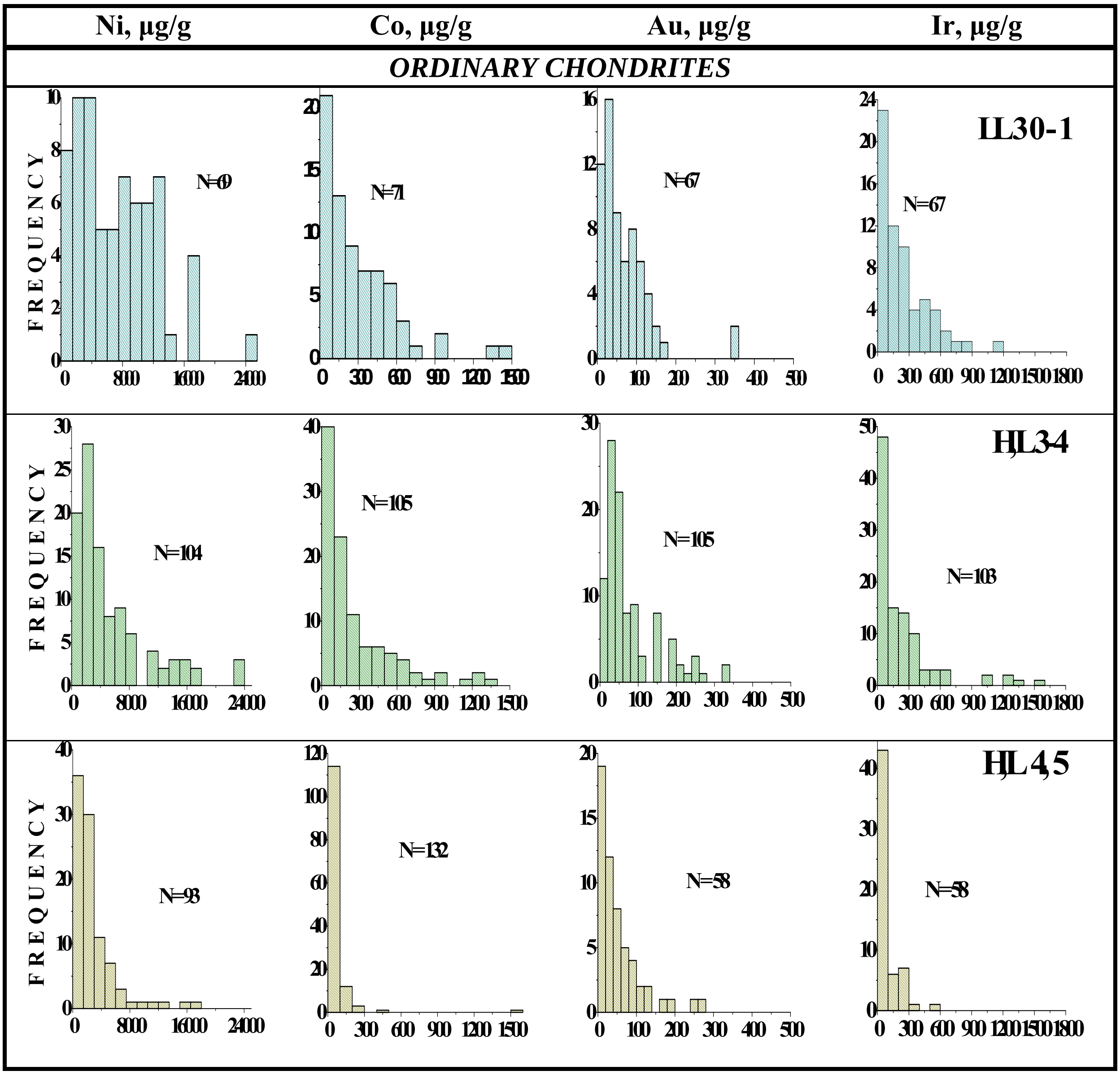

Fig.2. Frequency histograms for Ni Co, Au and Ir distribution in chondrules of ordinary chondrites: **LL3.0-3.1** – Semarkona [6,7], Krymka [6]; **H,L3-4** – Chainpur [8], Sharps [9], Y-790986[10], Andreevka [11]; **H,L4,5** – Saratov, Ochansk [2], Elenovka[11]

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