
Whitby et al. [5] determinarono l’età I-Xe di Zag. La media 4.8 ± 0.9 Ma di Zag in Bjurböle, diede un buon esempio che le halite sono state formate in un sistema solare prossimo, cioè, prima di Al-lende CAIs [6]. Poiché halite formation must have been a parent body process, this age would require the existenza of sizeable parent bodies before CAI formation. Busfield et al. [7] measured the I-Xe age of Monahans, mostrando le età scatte e più tardi del Zag. H. Zolensky et al. [4] presentano che le halites del Zag e del Monahans sono state formate 5 Ma dopo Shallowater, equivalenti a 5.5 Ma dopo Bjurböle. In questo contesto, l’età I-Xe del Zag scatta intorno alla media del Zag, suggerendo che un modello estremamente sofisticato è necessario per interpretare la forma di halite. Invece di halite, i halites del Zag e del Monahans sono state formate in un sistema solare prossimo, cioè, prima di Al-lende CAIs [6]. Il modello estremamente sofisticato è necessario per interpretare la forma di halite. Invece di halite, i halites del Zag e del Monahans sono state formate in un sistema solare prossimo, cioè, prima di Al-lende CAIs [6].
block-B containing a visible halite crystal. The $^{129}\text{Xe}$-excess is dominant in temperature fractions of 900 to 1100°C as shown in Fig. 1. Total concentrations of the excess $^{129}\text{Xe}$ are from $2\times10^{-10}$ to $6\times10^{-10}$ cm$^3$STP/g in matrix samples from block-A and -B, respectively. These results indicate that the matrix materials are enriched in both halogens and noble gases of solar origin.

**Noble gases by laser microprobe analysis.** Noble gas concentrations and isotopic ratios were measured for chlorapatite, matrix, metal and carbonaceous chondrite-like fragment. Low $^{38}\text{Ar}/^{36}\text{Ar}$ of 0.144 for chlorapatite, matrix, metal and carbonaceous chondrite fragments in Zag meteorite as reported in [9].

$I$-Xe dating for matrices and clast. Xe isotopic ratios for neutron irradiated samples were measured on a modified VG3600 mass spectrometer employing stepwise heating at the Radioisotope Center of University of Tokyo [10]. Based on the linear correlations appeared in the diagram for $^{125}\text{Xe}/^{132}\text{Xe}$ vs. $^{129}\text{Xe}/^{132}\text{Xe}$ at the temperatures $\geq1200°C$, we obtained I-Xe ages of $17\pm1$ Ma (matrix from block-A), $20\pm1$ Ma (matrix from block-B) and $34\pm7$ Ma (clast from block-A) after the age of Bjurböle. As shown in Fig. 2, the determined ages of matrix, which are classified as H4, are about 10 Ma later than those for low metamorphism chondrites, while the age for clast is in the range of high metamorphism chondrites within the error limit. Although the concentration of $^{129}\text{Xe}$ excess was larger for the matrix from block-B in the stepwise heating analysis, only a small difference between the determined ages was found for the two matrices.

Since the $^{129}\text{Xe}$ excess extracted at $<1200°C$ would be from halites as shown in Fig. 1, the I-Xe ages determined here represent the ages of materials except halite. Even if the I-Xe ages for halites from Zag and Monahans are as young as 5 Ma after Shallowater as noted above, the ages for bulk samples obtained in this work show much later resetting events for I-Xe system on the Zag parent body compared with those for halite crystals. If halite crystal was incorporated in the Zag matrix before the ages for matrices (15-20 Ma after Bjurböle), our results indicate that the I-Xe system for materials other than halites was reset.

Candiates for the events to reset the I-Xe system can be listed as thermal metamorphism, shock metamorphism, and aqueous alteration. In the case of thermal metamorphism, the Zag parent body must have been heated at temperatures $\geq1200°C$ to destroy the observed linear correlation between $^{125}\text{Xe}$ and $^{129}\text{Xe}$. However, the ancient halites would have melted at such high temperatures, because the melting point of halite is about 800°C. It is not clear whether the shock metamorphism is effective for the reset of I-Xe system. Caffee et al. [12] suggested based on their shock experiments that I-Xe system was disturbed by the shock metamorphism but could not be reset completely. Aqueous alteration looks the most unsuitable from the perspective of the preservation of halite, since halite is characterized by its solubility in water. Nevertheless, it cannot be neglected due to the results of water treatment in our experiment, in which $^{129}\text{Xe}$ excess in matrix remained through the water treatment.

It is suggested by this work that I-Xe resetting event occurred at about 20 Ma after Bjurböle, which is an additional event to the known two events for the Zag meteorite; 1) halite deposition from aqueous fluid [e.g., 7], and 2) brecciation by large impacts at 320 Ma after Bjurböle [5].

**References:**


![Fig. 2. I-Xe age distribution for meteorites. (After Yurimoto [11]).](image-url)