FORMATION MECHANISM OF ZIRCONS IN MESOSIDERITES.

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Introduction: Zircon is highly resistant to thermal annealing compared to the other constituent minerals in meteorites. The ^{207}Pb–^{206}Pb ages of zircons from basaltic eucrites [e.g., 1, 2] and a mesosiderite [3] have clustered at 4.55–4.56 Ga, which have been considered to be formation ages of zircons during magmatism on the parent bodies. However, recent studies on zircons from highly metamorphosed basaltic eucrites revealed that some zircons could formed and/or overgrown during subsolidus reheating events [4, 5]. This formation process suggests that zircons from the meteorites which experienced the reheating events above the subsolidus temperature could form during metamorphism. In this study, we will focus on zircons in mesosiderites and discuss formation mechanism based on their geochemical characteristics and chronological data.

Results and Discussion: The trace element compositions revealed that there are two types of zircon in mesosiderites [3, 6]. One is the zircon which has similar chemical compositions to zircons in basaltic eucrites. These zircons are considered to be a relict zircon that could have formed on the parent body of silicate parts. Another type is characterized by extremely low REE, U, and Th contents (U, Th contents < 1 ppm). This type of zircon is unique to mesosiderites, and therefore it could form during or after the formation of mesosiderites (hereafter secondary zircon).

The zircons in highly metamorphosed basaltic eucrites could have formed and/or overgrown during the subsolidus annealing event by a reaction of silica and Zr derived from ilmenite [4, 5]. Formation mechanism of the secondary zircon is probably similar to that of the basaltic eucrites. The thermal event that produced the secondary zircon is considered to be the metal-silicate mixing event. It has been reported that the metal parts provided P to the silicate parts during the mixing event, which resulted in abundant phosphate minerals in mesosiderites [7]. Considering the chemical composition of the secondary zircons, they could have formed after incorporation of REE, U, and Th into the phosphate minerals. Besides, the fate of the relict zircons seems to have depended on the metamorphic grade. The relict zircon in Vaca Muerta (low metamorphic grade) shows the ^{207}Pb–^{206}Pb age of 4563 ± 15 Ma [3]. On the other hand, that in Estherville (high metamorphic grade) shows young ^{207}Pb–^{206}Pb age of 4520 ± 27 Ma [6]. The results suggest that the U–Pb system of the relict zircon in Vaca Muerta could not be affected by the annealing event during the metal-silicate mixing event, but that in Estherville could be completely reset at that time.

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