LATE THERMAL EVOLUTION OF ACAPULCOITES-LODRANITES PARENTBODY: EVIDENCE FROM SM-ND ISOTOPES AND TRACE ELEMENTS OF THE LEW86220 ACAPULCOITE.

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Introduction: Acapulcoites and lodranites are similar in mineralogy, major element and oxygen isotopic compositions [1,2]. They are considered to have been produced by partial melting [3] and are thus may provide important information about the early melting histories of the meteorite parent bodies. Except for a few cases, however, the chronological and detailed trace element data for these meteorites are still limited. We present here results of Sm-Nd isotopic and lithophile element analyses for four bulk acapulcoites-lodranites samples as well as mineral separates from one of the acapulcoites, LEW86220.

Samples and Analyses: Seven bulk samples from three acapulcoites (LEW86220, ALH81261, ALH81187), one lodranite (GRA95209) and one intermediate sample (EET84302) were analyzed for isotopic composition by using Finnegan MAT 262 and/or lihophile elements by ID and ICP-AES. In addition, six mineral separates from the LEW acapulcoite were also analyzed for Sm-Nd (note: The abundance data were partially reported previously in [4].

Results and discussion: As shown in Fig. 1, all acapulcoites show systematic depletion of alkalis and nearly CI-chondritic REE (except for Acapulco REE which is not shown here). GRA (lodranite) show systematic lithophile fractionations; Rb<K<Sr=Eu< LREE<Na<Li<HREE. Partial melting calculation suggests that silicate-melts of a few % for acapulcoites and about 15% for GRA were segregated from the chondritic sources.

Three bulk meteorites (two acapulcites ALH81261 and ALH81187 and one lodranite, GRA) indicate a model age of 4.55±0.03 Ga calculated from the initial $^{143}Nd/^{144}Nd$ ratio of LEW 86010 [5]. On the other hand, LEW shows a model of 4.59±0.03Ga. (Recently we recalibrated Sm-Nd spike solution and found that our previous Sm-Nd data [6] are found to include small errors). The LEW86220 model age appears to be slightly higher than those of other acapulcoites-lodranites, suggesting that the meteorite experienced a secondary Sm-Nd disturbance. In order to examine detailed Sm-Nd isotopic signatures recorded during the secondary event and to determine the time of the event, we have carried out Sm-Nd isotopic analyses for six mineral separates (clinopyroxene [CPX], orthopyroxene [OPX], phosphate [PH], plagioclase [PL], whole-rock leachate [WR-L] and whole-rock residue [WR-R]) and two whole-rock samples [WR-1, -2] from LEW86220.

As shown in Fig. 2, most of LEW86220 data points, except for plagioclase, define a linear array, indicating that the Sm-Nd isotopic system has been reset but not for plagioclase by a late thermal event. The slope and intercept of the line corresponds to an age of 4.13 ±0.10Ga and an initial $^{143}Nd/^{144}Nd$ ratio of 0.50732±0.00015 (εCHUR=+1.3±3.0), respectively. The data point of plagioclase clearly deviated from the 4.13 Ga regression line (deviation:δNd=-1.3±0.08). The ^{147}Sm-^{143}Nd model age of plagioclase calculated from the LEW86010 initial ratio [5] is 4.56±0.04Ga, suggesting that the Sm-Nd system has been closed since the early formation of the meteorite and have not been influenced by the late thermal event. This is reconciled with the least diffusivity of NaSi-CaAl in plagioclase among constituent minerals such as cline- and orth-pyroxenes (though diffusivities of REE in plagioclase are not well known).

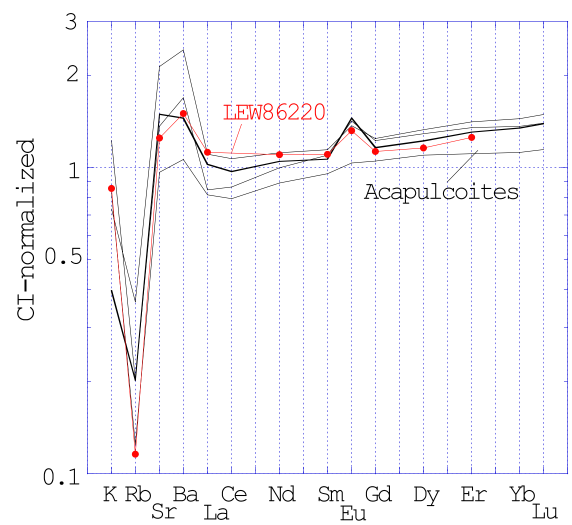

Fig. 1 Trace element patterns for acapulcoites.

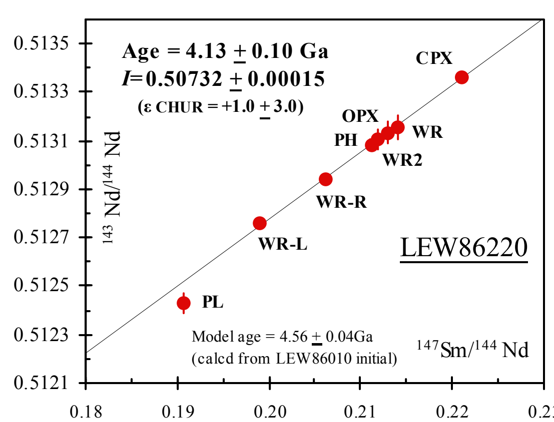

Fig. 2. Sm-Nd evolution diagram for LEW86220

This age is clearly younger than the Sm-Nd age of 4.60± 0.03Ga reported for Acapulco [7], as well as typical formation age (4.55Ga) of angrites [5] and would thus provides an evidence for a late thermal event occurred on the parent body of acapulcoites-lodranites. The slightly high initial $^{143}Nd/^{144}Nd$ ratio relative to CHUR (though with a large error) suggests that LEW86220 evolved as slightly subchondritic elemental Nd/Sm ratio from the 4.55Ga to 4.1Ga. We, therefore, suggest the LEW86220 formed by igneous event at 4.55Ga, accompanied by slight light-REE depletion and followed by moderately-intense metamorphic event 400m.y. later.

It is reported that LEW86220 is unique in its texture [3], having two types of lithologies, fine-grained (grain-seizes; 150±70µm) (acapulcoite type) and coarse-grained (lodranite type) (grain-sizes; 1-3mm). Plagioclase grains have homogeneous compositions (An15.1±1.1) in the acapulcoite lithology but variable compositions (An8.6-18.5) in the lodranite lithology [3]. It is thus interesting to see if the young metamorphic event as recored in Sm-Nd isotopes is related to such unique lithologies or not. Under binocular microscopes, our samples analyzed here appeared to be coarse grained. However, unfortunately, we have not yet obtain An composition of plagioclase separates studied for Sm-Nd isotopes. So analyses of residual plagioclase samples are in progress.

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