

## High pressure and temperature polymerization of amino acids suggesting a role of depth in the crust for chemical evolution

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### Introduction

Almost all previous experiments and theories on the origin of life have been based on a priori assumption that chemical evolution proceeded in the ancient oceanic environment such as hydrothermal vent and lagoon etc. However, the assumption faces to the inconsistency that dehydration polymerization of organic molecules proceeds in the excess amount of water. To clear the difficulty, a scenario has been proposed: Chemical evolution performed in the process of dynamical flow of the Earth's upper-crust (Nakazawa et al., 1993). In the process, sea sediment contained organic molecules meets to high pressure and temperature conditions of diagenesis. We investigate experimentally whether amino acids are polymerized in sediment under the probable pressure and temperature of diagenesis.

### Experimental

Model samples of sea sediment were prepared by adsorption of L-alanine (Wako Chemicals) on Namontmorillonite (Kunipia F, Kunimine Co.). The samples were sealed in gold capsules and treated by an autoclave at 150 to 250 degrees centigrade and 100MPa for 24 hours. From the run products, organic molecules were extracted by 0.1% TFA aqueous solution and analyzed by a high performance liquid chromatography (HPLC). Some molecules of fairly high yield were separately collected, freeze-dried and confirmed by a Fourier transform infrared spectroscopy (FT-IR) whether they have peptide bonding. Their molecular weights were determined by a matrix assisted laser desorption ionization time of flight mass spectrometer (MALDI-TOFMS).

### Results and discussion

HPLC analysis of run products indicated that various organic molecules were formed under the different condition. Some of them were oligomers up to pentamer having certain peptide bonds as indicated by FT-IR spectra and MALDI-TOFMS measurement although the identification of all molecules have not been completed yet.

These results indicate that amino acids adsorbed on clay minerals are polymerized under the probable temperature and pressure at the depth of 5km in the crust. More precise control of compaction and dehydration processes of them may perform further polymerization than pentamer. The present experiment is consistent with the hypothesis that chemical evolution proceeded in the upper-crust of the early Earth.

## Sm-Nd isotopic systematics and trace element geochemistry of the LEW86220 and other acapulcoites-lodranites achondrites

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Acapulcoites and lodranites are similar in mineralogy, major element and oxygen isotopic compositions (Clayton et al. 1992; Mittlefehldt et al. 1996). They are considered to have been produced by partial melting (McCoy et al. 1997) 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 samples (LEW86220).

Seven bulk samples from three acapulcoites (LEW 86220, ALH81261, ALH81187), one lodranite (GRA95209) and one intermediate sample (EET84302) were analyzed for isotopic composition by using Finnegan MAT 262 and lithophile elements by ID and ICP-AES. In addition, six mineral separates from the LEW acapulcoite were also investigated for Sm-Nd (note: Part of the abundance data were reported previously by Morikawa & Nakamura, 1996).

All acapulcoites show systematic depletion of alkalis and nearly CI-chondritic REE (except for Acapulco REE). GRA 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 plot on the 4.56 Ga reference line in a <sup>147</sup>Sm-<sup>143</sup>Nd evolution diagram but not for LEW which is unique in composition and texture (McCoy et al. 1997), indicating that LEW was disturbed by the secondary event(s). On the other hand, the seven LEW mineral data among eight, except for plagioclase, define a linear array, the slope of which corresponds to an age of 4121±65 (2σ) Ma and an initial <sup>143</sup>Nd/<sup>144</sup>Nd ratio of 0.50732±9. This age is the first Sm-Nd age of the primitive achondrite significantly (400my) younger than the typical formation age (4.55Ga) of angrites (Lugmair & Galer 1992) as well as Acapulco (Prinzhofer et al. 1992) and would thus provides a clue to a late thermal event(s) occurred on the parent body of primitive achondrites.

### References

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