DEVELOPMENT OF SAMPLING TECHNIQUES FOR EXTRACTION OF AMINO ACIDS FROM GEOLOGICAL SAMPLES

Interim or Final Report

JPL Task 1032

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A. OBJECTIVES

These experiments were designed to simulate in a very simple manner a cartridge-type extraction of amino acids from granular soil-type material. Two rock/soil simulants were used, ground ultrapure silica and JSC-1 Mars soil simulant (palagonite). Both simulants were baked in air at 500ºC for 2 hr to remove any organic contamination. In each experiment, approximately 1 cm^3 of soil simulant was spiked with a mixture containing racemic mixtures of several amino acids at concentrations of approximately 10^{-5} M. The samples were dried under vacuum and then placed in a 5 ml plastic hypodermic syringe with a cotton plug at the bottom. Ultrapure water was heated on a hot plate and the desired volume (either 2 or 4 ml) added to the syringe. The water was then pushed through the sample slowly over the time indicated (either 2.5 or 5 min.). The extract was collected in an Eppendorf tube and dried under vacuum, then resuspended in a smaller volume of water and analyzed using o-phthaldialdehyde/N-acetyl-L-cysteine derivatization and HPLC separation [1].

B. PROGRESS AND RESULTS

1. Science Data

Extraction from silica for 2.5 min. with a 2:1 water:rock ratio yielded only about 50% extraction efficiency. However, an increase in extraction time to 5 min. yielded efficiencies comparable to standard laboratory procedure (100ºC, overnight). An increase in the water:rock ratio to 4:1 did not improve extraction efficiency from silica significantly (Figure 1).

Extraction from palagonite is somewhat more problematic (Figure 2). Even with 5 min. extraction and 4:1 water:rock ratio, extraction efficiencies remained at 20-60% relative to overnight extraction. The acidic amino acids (aspartic acid, glutamic acid) show lower efficiencies than the others, probably due to ionic interactions with cations in the palagonite. Use of a high salt solution and a 10^{-3} M hydrochloric acid solution did not increase the extraction efficiency from palagonite.

C. SIGNIFICANCE OF RESULTS

The increase in extraction time from 2.5 to 5 min. resulted in a modest increase in efficiency in most cases. Further increase in extraction time should be pursued, with a modified apparatus that can keep the sample warm over the extraction time scale. There will be a maximum practical extraction time for an in situ instrument, probably at least 15-30 min. The water:rock ratio of 4:1 is probably about as high as can be reasonably achieved in situ, so the focus for now will be on increased extraction times.

D. FINANCIAL STATUS

The total funding for this task was $50, 000, all of which has been expended.

E. PERSONNEL

No other personnel were involved.

F. PUBLICATIONS

None.

G. REFERENCES

[1] K. L. F. Brinton, A. I. Tsapin, D. Gilichinsky and G. D. McDonald, "Aspartic acid racemization and age-depth relationships for organic carbon in Siberian permafrost", *Astrobiology* 2, 77-82, 2002.

H. APPENDIX: *FIGURES*

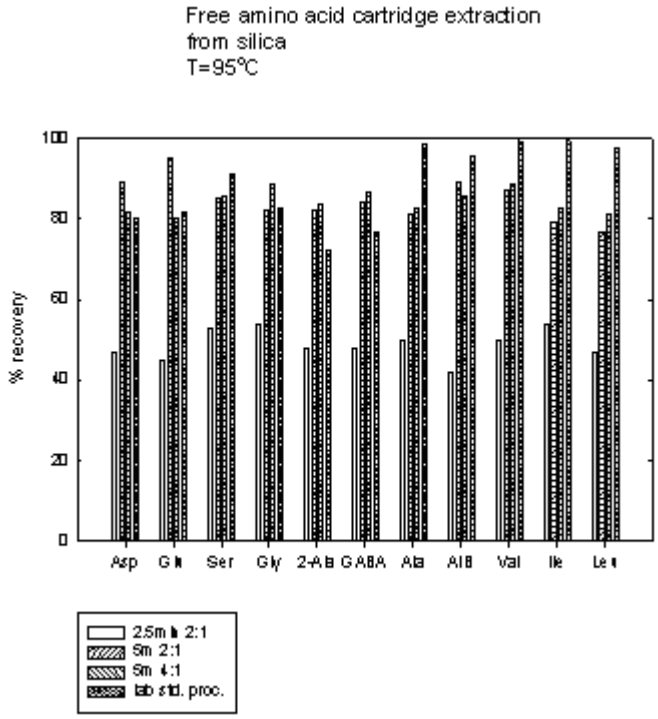

Figure 1. Extraction efficiency of amino acids from silica at various extraction times and water:sample volume ratios.

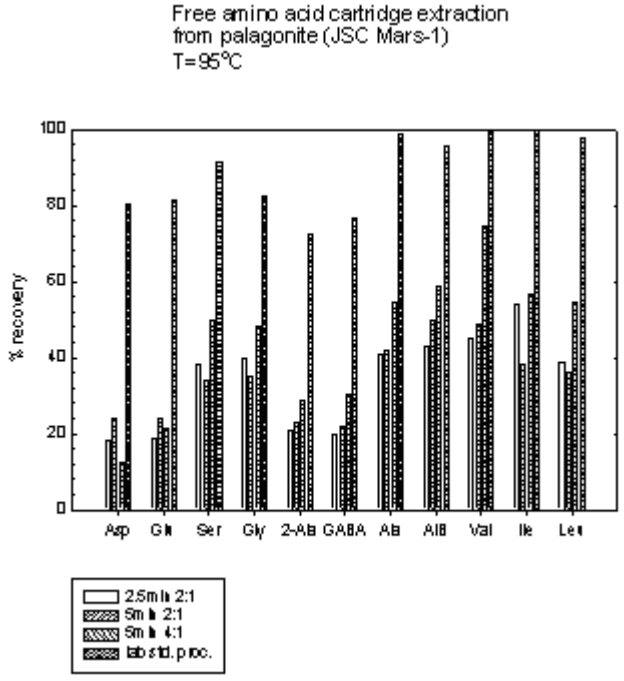

Figure 2. Extraction efficiency of amino acids from palagonite at various extraction times and water:sample volume ratios.