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"CONTAINERLESS" HIGH-PRESSURE PETROLOGY EXPERIMENTS IN THE MICROGRAVITY ENVIRONMENT OF THE SPACE STATION

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Problem

The genesis of igneous rocks on terrestrial planets can only be understood through experiments at pressures corresponding to those in planetary mantles (10-50 kbar). Such experiments typically require a piston-cylinder apparatus, and apparatus that has the advantage of controllable pressure and temperature, adequate sample volume, rapid sample quench, and minimal danger of catastrophic failure. The experimental charge must be prevented from touching the walls of the cylinder and so is usually encased in a capsule of platinoid metal or alloy. Unfortunately, the platinoid containers usually can dissolve significant Fe (and other transition metals) from the experimental charge (at the oxygen fugacities appropriate for magma genesis) and, thus, results in alteration of the chemical composition of the charge. The strategies available to eliminate this problem in terrestrial laboratories reduces the applicability of the results of realistic natural conditions.

Solution

We propose to perform high-pressure and -temperature, piston-cylinder experiments aboard the Space Station. The microgravity environment in the Space Station will minimize settling due to density contrasts and may, thus, allow experiments of moderate duration to be performed without a platinoid capsule and without the sample having to touch the container walls. The ideal pressure medium would have the same temperatures. It is emphasized, however, that this proposed experimental capability requires technological advances and innovations not currently available.