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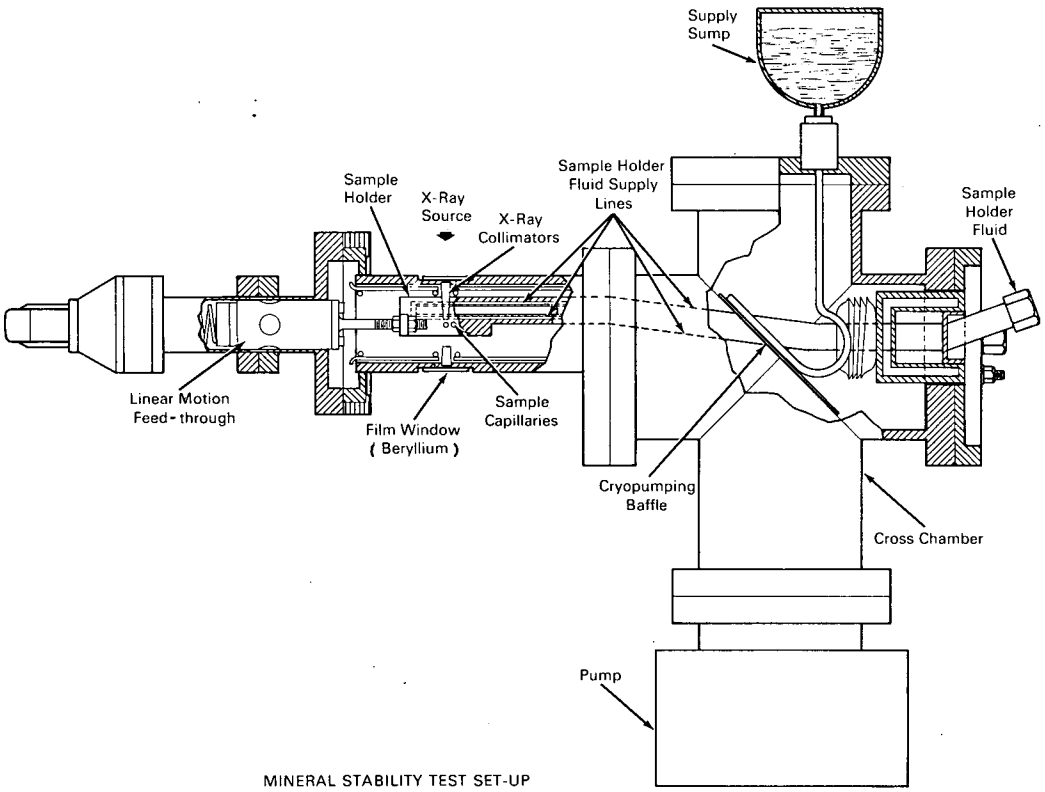
NASA TECH BRIEF

Method for X-Ray Study Under Extreme Temperature and Pressure Conditions



MINERAL STABILITY TEST SET-UP

The problem:

To study the stability of various minerals in extreme environmental conditions. It is necessary to evaluate the stability of earth minerals in simulated lunar and spacecraft environments, and present methods of simulation and sample positioning are not suitable to achieve this.

The solution:

A vacuum chamber environmental simulator and X-ray camera provide the desired conditions. A 500 liter/sec ion pump is used to create the desired vacuum and exact sample positioning is obtained with a bellows sealed linear motion feed-through. Temperature control is by means of fluid conductive heat transfer.

How it's done:

The environmental simulation system is set up in a 6-inch diameter cross chamber with the ion pump attached as shown. This pump is used to maintain the specific pressure desired.

(continued overleaf)

Sample holder positioning is provided by a micrometer head connected to the sample holder by a bellows sealed linear motion feed-through. The purpose of a bellows device is to insulate the testing chamber from undesirable temperature gradients.

To control the temperature of the samples under test a cryopumping system is employed. A suitable liquid is maintained at the proper temperature in a supply sump. From this supply, lines carry the liquid to the cryopumping baffle where it controls the temperature of the sample holder fluid. The sample holder fluid is then circulated through the sample holder. Specifically, LN_2 is used in the supply sump with a liquid level control system providing a constant-head gravity feed flow to the baffle. This system was developed to avoid varying flows that create intolerable fluctuations in the chamber pressure.

The samples themselves are sealed in glass capillaries and then inserted in the stainless steel sample holder block as shown. The intimate proximity of the sample holder fluid and sample capillary provide the needed temperature control. The X-ray camera housing includes a thin beryllium strip window, to provide transparency for the X-ray diffraction beam to the recording film.

In operation, the sample is precisely positioned in the X-ray beam path with the micrometer head. X-ray studies can then be made in the desired temperature range. Due to thermal expansion, precise adjustment of the sample holder block may be necessary before each exposure.

Notes:

1. This method was used to test in the temperature range from $-180°C$ to $130°C$ and at pressures to the order of 10^{-10} torr.
2. Standard copper X-ray tubes may not be satisfactory for certain samples and replacement with a molbydenum X-ray tube may yield better results.
3. The bellows seals for the fluid tubes were necessitated by the fluid conductive heat transfer method of sample temperature control. Three-quarter-inch bellows movement was required for sample movement in front of the X-ray collimators in the tests carried out.
4. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B67-10474

Patent status:

No patent action is contemplated by NASA.

Source: Lloyd L. Paus
of Bendix Aerospace Systems Division
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