SIXTH TECHNICAL PROGRESS REPORT
For the Period July, August, September 1966

DEVELOPMENT OF TECHNOLOGICAL CONCEPTS LEADING TO THE BENEFICIAL USE OF LUNAR MAGMA PRODUCTS

Contract NAS 7-358

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ACTIVITIES LAST QUARTER

During the last quarter we concentrated our efforts on the analyses of natural serpentine and synthetic olivine, trying to find a comparison with natural dunite. We have made a total of 108 new determinations of the solid-liquid phase transformations of serpentine and olivine. This brings the total number of determinations to date to 596 at a rate of 1.64 experiments per working day (based on 22 working days per month and no vacations). As we stated in the previous report, these numbers reflect the cost efficiency of performing the experiments but have no bearing on the analyses of the results. In addition, several experiments were conducted as a trial application of the data gained in the above study to casting and forming of basic rocks.

NEW DATA

Serpentine - A study of serpentine at 10 and 35 kilobars has been completed and a study at 45 kilobars is almost complete.

Antigorite, which is the major constituent of the serpentine, persists at temperatures up to 650°C even at 45 kilobars. At lower pressures, however, it seems to persist at temperatures 50 to 75°C higher than that.

At the higher temperatures, olivine (forsterite) is dominant and pyroxene (enstatite) is abundant. The upper temperature limits for this zone rise from 800°C at 10 kb to 900°C at 35 kb to 1100°C at 45 kb.

At still higher temperatures, pyroxene is dominant. Olivine is abundant up to at least 35 kb, but between 35 and 45 kb it disappears completely and pyroxene is the only crystalline component in the zone.

Above this, a 100% glass zone persists. The liquidus curve which is at 1350°C at 10 kb rises to 1450°C at 35 kb and to 1475°C at 45 kb.

As a matter of record it is important to note two contaminants.. One, boron phlogopite in the region of approximately 600-900°C noted at pressures of 10 and 35 kb but not at 45 kb; two, boron magnesium oxide noted at 1450°C at 35 kb.

The significance of the above data:

It is obvious from a quick examination of the data that the temperature dependence of the de-serpentinization (dehydration of the serpentine) is far greater than the pressure dependence. Should serpentine be found on the moon, then a water extracting process would probably be carried through temperature manipulation rather than pressure manipulation.

Another very important significance is that the zones of stability of olivine vs. pyroxene measured in terms of pressure and temperature can be expressed also in terms of depth vs. temperature in models of the moon and the earth.

Olivine - For comparison with the natural dunite, artificial olivines (fayalite) were hydrothermally synthesized from mixtures of α-cristobalite (quartz) and native pure iron prepared in stoichiometric proportions of the mineral. Melting was detected in a series of high pressure runs by noting a conspicuous difference in texture between runs which had recrystallized from liquid during quenching and those which had recrystallized below the melting points (see figure).

PLANNED ACTIVITIES FOR NEXT QUARTER

We will continue the examination of serpentine and olivine and begin to integrate the results into a planetary model (for correlation of laboratory data with natural-environment data). We will begin to determine petrographic properties of cast and formed geometric shapes (made of basic rocks) and postulate possible utilities.

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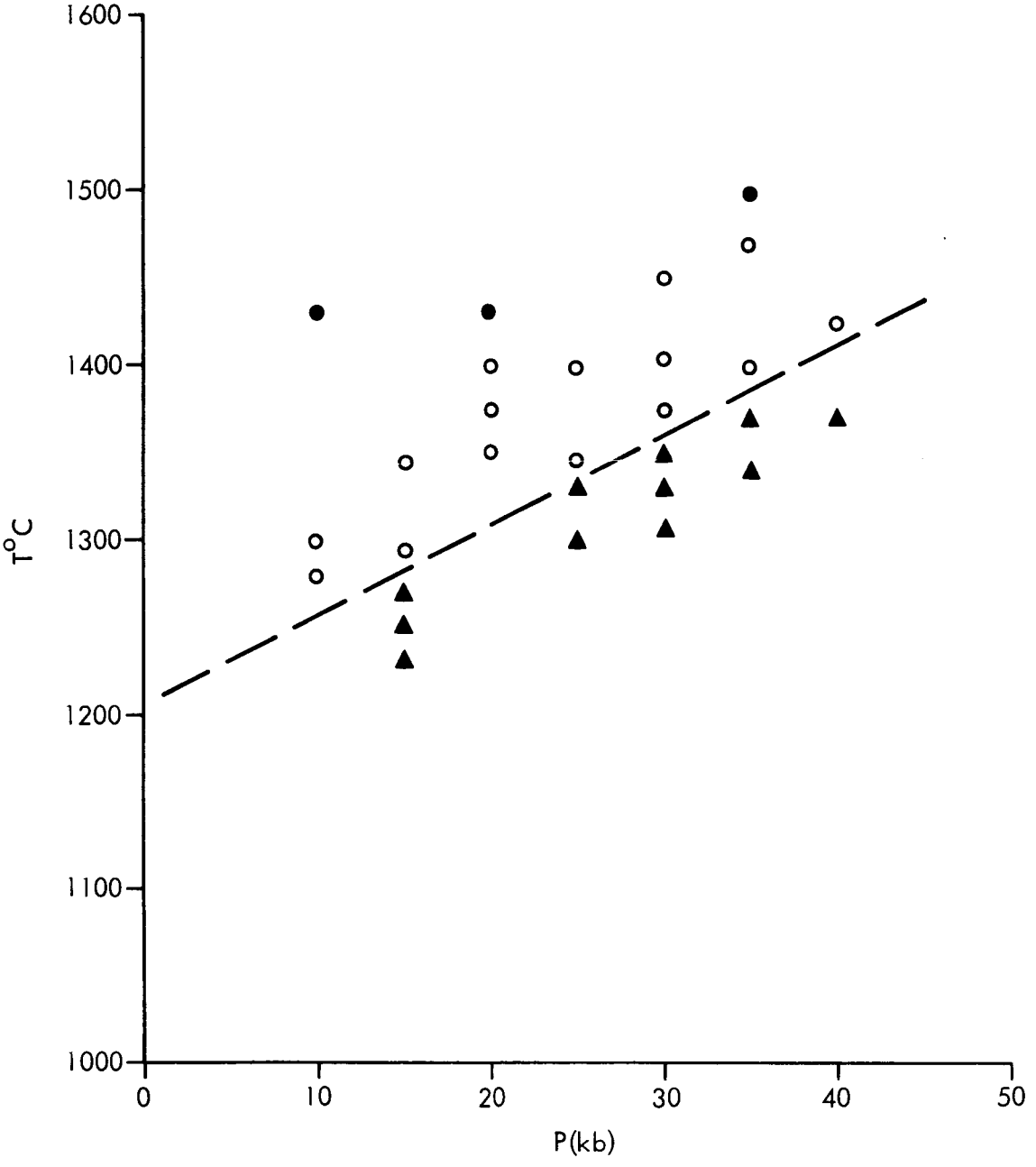

● GLASS QUENCH PRODUCTS
o CRYSTALLINE QUENCH PRODUCTS
▲ UNALTERED FAYALITE

MELTING CURVE FOR FAYALITE