stoning. In many cases etching with the proper solvent will bring out these structures and greatly facilitate the measurements.

Essentially the method consists of measuring the "dip" and "strike" of the planar element on two polished surfaces at right-angles to each other (with, of course, a correction for the "dip" when not measured perpendicular to the "strike"). The pole to the planar element can then be plotted on the conventional Schmidt net.

This technique has been used in preparing fabric diagrams of the ilmenite from the St. Urbain, Quebec, titaniferous iron-ore deposit. In this case the measurements were greatly facilitated by the presence of exsolved plates of hematite parallel to (0001) of the ilmenite. Subsequent plotting of the pole to these plates gives a diagram equivalent to a c-axis diagram of ilmenite.

The most unusual feature of the ilmenite orientation is the lack of symmetry in the fabric diagram. A megascopic s-surface is denoted by the alignment of the somewhat platy ilmenite grains. This s-surface has no symmetrical relation to the statistical or lattice s-surface brought out by the plotting of the c-axis of the ilmenite grains. The degree of preferred orientation of the ilmenite is surprisingly high with maxima up to 12 per cent of the grains in a one per cent area. This lack of symmetrical coincidence of the dimensional and crystallographic orientations undoubtedly is related to the origin of the fabric.

There are two theories for the origin of the St. Urbain ilmenite deposit, one theory being that the ilmenite was injected as a magma essentially of ilmenite composition, hence making the fabric depositional in origin. The second theory ascribes their origin to a replacement-process, making the fabric the result of volume for volume replacement of the enclosing anorthosite. The mechanism of imparting such a high degree of preferred orientation to a mineral by metasomatic processes deserves more study and may have wider application in the more common rocks as well as in ore-deposits.

Fabric diagrams of the andesine of the enclosing anorthosite were prepared. The preferred orientation is not so pronounced [c-axis diagram maxima, 3.5 per cent; (010) diagram maxima, 6 per cent] as that of the ilmenite, and here again there is no symmetrical relation between the statistical s-surfaces indicated by the (010) or the c-axes of the andesine and the megascopic or the statistical s-surfaces in the ilmenite.

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PLASTIC BASINING OF THE PACIFIC AND ITS RELATION TO GLACIATION AND SUBMARINE CANYONS

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No abstract or manuscript of this paper, which was presented by title, was submitted.

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VARIATIONS IN PHYSICAL PROPERTIES WITHIN THE EARTH'S CRUSTAL LAYERS

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(Abstract)

An investigation of amplitudes of $\overline{P}$-waves in southern California in about 300 instances, having epicentral distances from 50 to 570 km, indicates that the velocity V of longitudinal waves in the granitic layer at depths h (in km) between about 2 km and its bottom at about 18 km is given by $V = (5.56 + 0.001\ h)$ in km/sec. The second term is a first approximation only and indicates an increase in the bulk-modulus by about 3/4 per cent corresponding to an increase in pressure by 1000 atmospheres. This is of the same order of magnitude as the values found for granite in laboratory experiments and from the theory of finite strain.

Similarly, the investigation of Py-waves gives a velocity of [6.0 + 0.01 (h-18)] in km/sec for the (first) intermediate layer and a resulting increase in the bulk-modulus by about 1-1/4 per cent per pressure increase of 1000 atmospheres. Travel-times as well as amplitudes lead independently to the conclusion that most of the 50 shocks used originated at the bottom of the granitic layer. In shocks with faulting completely inside the granitic layer only, the amplitudes of Py should be about the same size as those of Pn.

The fact that the amplitudes of the various S-waves change with distance in a similar way as those of the corresponding P-waves, indicates that the effect of pressure and temperature on the coefficient of rigidity is relatively the same as on the bulk-modulus.

The Mohorovičić discontinuity is at a depth of about 35 to 40 km in the coastal areas of southern California, but deeper under mountain ranges. The velocity of Pn below it is close to 8.0 km/sec. At first, the velocities of both, P and S, increase with depth, probably at a rate similar to that in the upper layers, but the rate of increase falls off rapidly with increasing depth, resulting in a rapid decrease of the amplitudes of Pn and Sn with distance beyond $\Delta = 200$ km. Amplitudes of Pn and similarly of Sn in intermediate shocks without appreciable surface-waves, on records of shocks originating at various depths within a radius of about 2000 km from Huancayo, Peru, and recorded at the station there, confirm the previous results of Gutenberg and Richter concerning the relationship between the epicentral distances at which the amplitudes of Pn are very small, and the focal depth of the shocks. These findings can be explained on the assumption that at a depth of about 80 km the melting-point of the material is reached. Immediately above that critical depth, the effect of temperature on the bulk-modulus and on the coefficient of rigidity may approach, or even surpass, the effect of pressure. At the critical depth itself, there may be a slight sudden decrease of the wave-velocity. At greater depth, the effect of the temperature on the bulk-modulus and the coefficient of rigidity becomes more and more insignificant. Whereas above the critical depth a certain minimum stress, the strength, is required to start plastic flow, below this depth no appreciable strength exists, and the plastic flow is controlled only by the viscosity of the material.

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