g/c.c. for the new phase. Unit cell dimensions of Co_2SiO_4 olivine were found to be $a=4{\cdot}779$, $b=10{\cdot}340$, $c=5{\cdot}996$ A. The density of the olivine calculated therefrom is 4·71 g/c.c. Thus the spinel polymorph of Co_2SiO_4 is 9·8 per cent denser than the olivine.

It was not possible to determine the transition pressure accurately. Although the pistons used in the high-pressure apparatus were constructed from the hardest available tungsten carbide ('Coromant *H*05') they were found to deform at pressures above 60 kilobars (largely because of the high operating temperature used—namely, 700° C). Consequently the effective area of the piston from which pressure is calculated was not well known. The best estimate for the pressure range under which Co_2SiO_4 spinel was synthesized is 70 ± 20 kilobars.

Parameters of olivine–spinel transitions known at present are compared in Table 2.

A. E. Ringwood

Department of Geophysics,
Australian National University,
Canberra.

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GEOLOGY

Rock Deformation in the Rim of the New Quebec Crater, Canada

The New Quebec Crater is a circular, lake-filled depression, two miles in diameter, in the arid Archean gneisses of northern Quebec. A bedrock rim encircles the crater, rising 1,300 ft. above the floor of the lake, and 300 ft. above the surrounding barren lands. Although an origin by meteorite impact was postulated for the crater 15 years ago[1] by comparison of the topographic form with that of known impact craters, detailed geological studies during 1962 have failed to discover meteorite fragments, highly shocked or shattered rocks.

In the absence of this material, the most valuable field evidence bearing on the origin of the crater is provided by measuring the deflexions of sheeting planes and other structures of the rim rocks from their original attitudes. Most readily and accurately measured is the sheeting, which in the region consists of smooth, parallel fracture planes spaced about one metre apart and dipping randomly at angles commonly less than 10°, rarely as great as 35°. Also of value are conspicuous lineations which are due to elongation of deformed basic inclusions, locally paralleled by rodding in enclosing quartzo-feldspathic rocks and in this region are generally normal to the sheeting. They help define steeply dipping sheeting in areas of the rim where it might be confused with other joint systems. Foliation and steeply inclined joint systems show greater regional variations in attitude.

No systematic orientation of sheeting was seen outside the topographic crater rim. Within the rim the dip decreases with distance away from the crest while deviations of strike from circumferential are considerable only where dips are less than 15°, and do not affect the gross features of this structure. The outward dip of the sheeting, as averaged over each 15° sector of the rim, varies from 9° in the south to 88° in the north-west. It is plotted in Fig. 1, which shows the sheeting dipping away from the crater with a crude bilateral symmetry about a north-west-trending axis. Where dips are low to moderate the upheaval and tilting of the bed-rock has been accommodated along pre-existing sheeting and joint surfaces, the

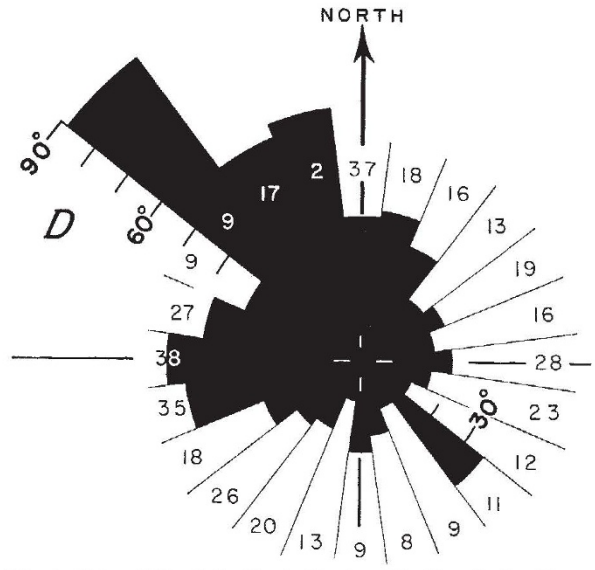

Fig. 1. Outward dip of sheeting in the rim of the New Quebec Crater. The radius vector *D* is the average angle of dip in each 15° sector. The numerals give the number of measurements averaged in each sector (total 433)

outcrops having the massive appearance typical of arctic Quebec. On the north-west and west side of the crater where dips are steeper, additional joint systems have developed. Here distinctive outcrops result from the rock being broken into numerous polygonal blocks by smooth, planar joint surfaces of variable orientation and spaced at intervals of 15–30 cm. No close-set irregular or conical fracture surfaces or zones of breccia were seen.

The localized intense upheaval and outward tilting of the bedrock in the rim is consistent with the crater being formed by an explosive event. Because the direction of the symmetry axis of the deformation shows no relation to that of regional foliation or joint systems, the symmetry is considered to reproduce that of the deforming force. This force is deduced to have originated along an inclined line, a conclusion compatible with the theory of impact origin for this crater.

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K. L. Currie

Geological Survey of Canada.

M. R. Dence

Dominion Observatory,
Ottawa.

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Some Relationships between Members of the Epidote Group

It has been generally accepted in the past that continuous solid solution existed in the epidote group between pure aluminium epidote, $Ca_2Al_3Si_3O_{12}.OH$ (*Cz*), and common iron epidote[1–3]. Four important minerals occur in this range; in order of increasing iron content they are α-zoisite and β-zoisite (orthorhombic), clinozoisite and epidote (monoclinic). They are distinguished on the basis of their optical properties.

Examination of the literature reveals several instances of associations of zoisite and clinozoisite[4], thulite (a manganese-bearing zoisite) and epidote[5], and clinozoisite and epidote[6]. Compositions in this communication will be given in terms of *Cz*, and the hypothetical iron end member $Ca_2Fe_3Si_3O_{12}.OH$ (*Ps*). Common epidote is approximately $Cz_{67}Ps_{33}$, but varieties with up to 46 per cent *Ps* are known.

Study of epidote group minerals in Ordovician volcanic rocks of Borrowdale, English Lake District, has revealed