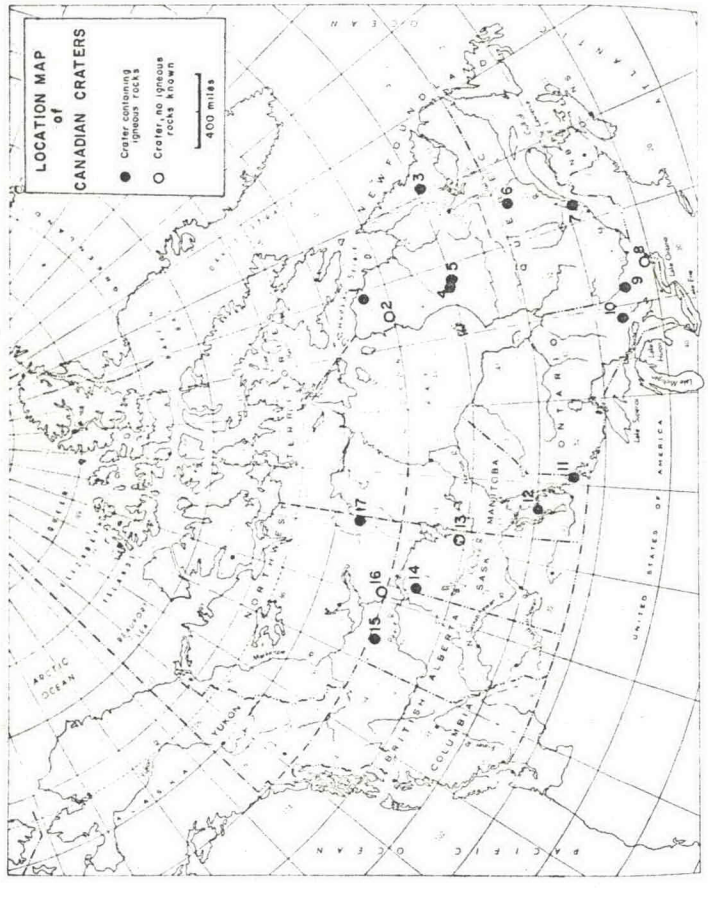




using these areas to weight the appropriate chemical analyses. Since this procedure is obviously inaccurate, in the most cases estimates of limiting compositions are also given.

## GEOCHEMISTRY OF INDIVIDUAL CRATERS

Although some information on the chemistry of the igneous rocks is available from 11 of the 13 craters, information on the chemistry and petrography of the accompanying breccias and country rocks is available for only 7 craters. All data are summarized in Table 1. Remarks on individual craters follow.

*Brent* is a bowl some 2900 meters in diameter and 960 meters deep, filled by some 650 meters of brecciated Precambrian rocks, overlain by Ordovician sedimentary crater fill [*Millman et al.*, 1960]. The Precambrian granite gneisses surrounding the crater are quite uniform in composition, permitting unusually accurate determination of the rock composition previously filling the crater. Table 2 shows the data used in estimating this composition.

Much of the breccia filling consists of almost unmetamorphosed fragments of the country rocks. Thin shock-metamorphosed zones [*Dence*, 1968] display a characteristic greenish cast, which is also found in breccia screens around the crater out to a distance of 800 feet. Analyses of these rocks (Table 2) show that they depart progressively from the composition of the Precambrian rocks toward that of the igneous rocks (Figure 2). Strongly metasomatized rocks contain anorthoclase and chloritized riebeckite and aegirine.

Fine-grained, red, vesicular trachyte occurs below the center of the Brent crater at depths of 1100 feet, and 2716–2850 feet, and on the northeast edge of the crater [*Currie*, 1969*a*], forming an arcuate dikelike mass. Chemically the rocks are olivine-normative alkaline trachytes (Table 2) similar to the altered breccias. Ocellar monchiquite dikes typical of the Nippising alkaline province [*Currie and Ferguson*, 1970] occur within and around the Brent crater. Their radiometric ages of 558 and 576 m.y. (M. Shafiqullah, unpublished data, and *Shafiqullah et al.* [1968]) agree with radiometric dates on other Nippising alkiline dikes. The carbonate matrix of breccias from the west side of the Brent crater yields $^{18}O/^{16}O$ ratios characteristic of carbonatite.

Brent lies on the Ottawa-Bonnechere graben system, which localized Nippising alkaline magmatism [*Currie*, 1970*a*]. With the exception of shock metamorphism, the similarity in size, shape, and petrochemistry of Brent to characteristics of the Callander Bay alkaline complex, 42 miles to the west, is very striking. The Newman Island alkaline complex, 12 miles west of Callander Bay, contains within its crater Ordovician sedimentary rocks correlative to those at Brent. In the absence of shock metamorphism, Brent would certainly be classified as an alkaline igneous complex within the Nippising alkaline igneous province.

*Mistastin Lake* is an elliptical crater roughly 13 by 20 km, cut mainly into homogeneous augen granodiorite [*Currie*, 1968]. A lens of anorthosite with marginal mangerite crosses the crater itself causing uncertainty in the composition of rocks within the crater. The available data and best estimate are shown in Table 3. Concentric ring dikes of igneous rocks cut shocked Precambrian on the shore of the lake and on a central island. Analyses of an older homogeneous fine-grained rock and a younger vesicular rock are shown in Table 3, together with analyses of younger igneous breccias that cross cut and include them. The igneous rocks are significantly depleted in silicon, potassium, and rubidium relative to average country rocks and are enriched in calcium and magnesium. Although proportions of country rocks could be adjusted to match the igneous composition (Table 3, column 7), it seems very improbable on field-mapping evidence that these proportions represent the original rocks within the crater.

Fig. 1. (*Opposite*) Known sites of shock metamorphism in Canada. In the following number key, a reference documenting the occurrence of igneous rocks is given where such rocks are known. (1) New Quebec crater [*Currie*, 1966]. (2) Lac Couture. (3) Mistastin Lake [*Currie*, 1968*a*]. (4) West Clearwater Lake crater [*Rostock*, 1969]. (5) East Clearwater Lake crater [*Currie and Shafiqullah*, 1968]. (6) Manicouagan [*Currie*, 1970*c*]. (7) Charlevoix [*Rondot* 1968; *Currie* 1969*b*]. (8) Holleford. (9) Brent [*Currie and Shafiqullah* 1967]. (10) Sudbury [*Collins* 1934; *Speers*, 1957]. (11) West Hawk Lake crater [*Short*, 1970]. (12) Lake St. Martin [*Currie* 1970*b*]. (13) Deep Bay. (14) Carswell [*Currie* 1969*c*]. (15) Steen River [*Carrigy*, 1968]. (16) Pilot Lake. (17) Nicholson Lake [*Dence et al.*, 1968].