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THE KORALEIGH STONY METEORITE

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Introduction

The stony meteorite (aerolite) herein described was found by Mr. F. A. Cudmore in March, 1943. It had been ploughed up from red soil near Koraleigh, in New South Wales, about twenty miles north-west of Swan Hill. The meteorite was submitted to us for mineralogical investigation by the Director of the National Museum, Mr. D. J. Mahony, and is now lodged in the National Museum, Melbourne.

General Description

The Koraleigh meteorite is only part of the original mass, since one of its six faces is a more or less flat fracture surface.

The weathered nature of the meteorite indicates that it has lain in the soil for a considerable period of time. Its rust-coloured exterior is due partly to reddish-brown limonite, and partly to small attached particles of red soil. During its period of burial, small particles of soil and occasional well-rounded grains of quartz became cemented on to surfaces of the aerolite by the iron oxides formed from the weathering of its metallic constituents.

The meteorite is irregular in shape, with six surfaces of varying size. Several of the surfaces show the "thumb-marks" so characteristic of meteorites. On one of the surfaces, a circular depression, measuring 7 mm. across, marks the position from which a hemispherical chondrule has broken out since the meteorite was collected. The flat base of this chondrule was on the outside of the aerolite, and may therefore have resulted from weathering. It was most likely spherical in its original condition.

The size of the meteorite is 9·3 cm. x 5·7 cm. x 5·0 cm. across its major dimensions. The mass weighed approximately 450 grams before slicing for mineralogical examination. Its specific gravity was determined as 3·41. This value is similar to that of the Caroline stony meteorite recently described in these Memoirs (Stillwell, 1941). Freshly fractured surfaces of the meteorite are dark brown to dark grey. Small soft patches of light-brown limonite are irregularly distributed through more weathered areas. The fresher surfaces show that minute patches of metallic minerals are disseminated throughout the meteorite.

Mineralogy

A thin section of the aerolite revealed that it is principally crystalline, with a granular to micro-porphyritic texture. Considerable staining by secondary hydrous oxides of iron has taken place right through the specimen.

The greater portion of the silicate minerals consists of granular olivine and crystals of bronzite with 2V approximately 90°. Occasional chondrules of the barred monosomatic variety and of the radiating and granular polysomatic variety are present. Twenty chondrules occurred in one thin section, measuring $\frac{7}{8}$ in. x $\frac{5}{8}$ in. The types of chondrules are similar to those occurring in the Bond Springs stony meteorite from Central Australia (Baker and Edwards, 1941), though they are not as numerous. The largest chondrule observed was the detached one measuring 7 mm. across; the smallest measured approximately 1 mm. in diameter.

Metal and iron sulphide grains are scattered throughout the section as small patches of irregular shape. They are frequently enveloped by limonite, the metal more so than the sulphide minerals.

The volume percentages of the silicate minerals and of the metal + sulphide were determined from 14 traverses, taken at 1 mm. intervals across a thin section, by means of an integrating machine. This resulted in a value of 9·7% for the metal + sulphide, with the sulphide mineral considerably in excess of the metallic iron. This percentage value is lower than that for the Bond Springs aerolite (12% by volume), partly because of considerable alteration by weathering of the iron in the Koraleigh aerolite.

The silicate minerals and small amounts of glassy material comprise the remaining 90·3% by volume of the aerolite. They have suffered slight decomposition, occasional alteration products (probably serpentine and iron oxide dust) occurring along cracks in some of the olivine crystals. They are invariably stained by thin films of secondary iron oxides derived from the metallic constituents.

Rare interstitial areas with low birefringence and vague twin lamellae are probably plagioclase felspar. Some of the clear areas between the grains and crystals of olivine and bronzite are uniaxial, negative, and probably correspond to the sodium-calcium phosphate mineral, merrillite, the presence of which was established by Stillwell in the Caroline stony meteorite.

Other rare interstitial areas which are clear and principally isotropic, represent maskelynite or devitrified glass. As in the Caroline stony meteorite, minute particles of reddish-brown colour and isotropic character, included in the olivine and pyroxene crystals, are regarded as chromite. Small opaque inclusions in certain of the olivine crystals are probably metallic iron and sulphides. Occasional rounded grains of a diopsidic mineral are also associated with the more abundant crystals of the silicate minerals.

Two varieties of pyroxene are present. One is the orthopyroxene, bronzite; the other shows oblique extinction, up to 36°, so that it is a clinopyroxene, probably augite. The orthorhombic variety is the more common of the two. Some of the pyroxene crystals exhibit wavy extinction, indicative of strain; rare examples of the clinopyroxene display lamellar twinning.

Opaque Minerals

The opaque minerals in the meteorite are pyrrhotite, α-iron (kamacite), limonite and (?) chromite. Pyrrhotite, the most abundant of the opaque minerals, forms areas which may be as large as 0·12 mm. x 0·25 mm. across, but are more commonly 0·10 mm. x 0·10 mm. in size. In reflected light, the pyrrhotite appears pinkish-brown. It is pleochroic and anisotropic. It can be distinguished from troilite by its etching properties. The pyrrhotite is relatively inert to 1 : 1 HNO_3 and 1 : 1 HCl, whereas troilite effervesces vigorously with these reagents. It was found by Stillwell (1941) that the sulphide mineral in the Caroline stony meteorite was also pyrrhotite.

The iron occurs as corroded remnants of grains which were originally equidimensional with the pyrrhotite, but are now partly altered to limonite. The iron is readily etched with HNO_3, $FeCl_3$ and $HgCl_2$, which indicates that it is α-iron (kamacite). No γ-iron (taenite) was detected. Small amounts, presumably of this mineral, were thought by Stillwell (1941) to occur in the Caroline aerolite. The iron is occasionally intergrown with pyrrhotite, but it is more usual for the two to occur as isolated grains.

The limonite commonly forms rims enclosing residual areas of iron. These rims are much more pronounced about the iron grains than around the pyrrhotite. They are connected with small veinlets of limonite which traverse the meteorite, and with a fine meshwork of limonite threads or films from 0·001 mm. to 0·002 mm. wide, which fill almost every grain boundary between the transparent minerals. The limonite occasionally forms parallel, needle-like inclusions and veinlets through the pyrrhotite.

Trevorite, which was recorded among the oxidation products of the metallic iron of the Caroline aerolite (Stillwell, 1941), was not located in the Koraleigh specimen.

The mineral which is thought to be chromite occurs as small, more or less idiomorphic crystals up to 0·02 mm. in diameter. It is grey-brown in reflected light, isotropic, and inert to standard etching reagents. The small crystals sometimes occur as groups within a single grain of the silicate minerals.

Conclusion

The aerolite from Koraleigh, in New South Wales, is a bronzite-olivine chondrite like that from Caroline, on the Glenelg River near the Victorian-South Australian border. Because of the close similarity of these two aerolites in the various characteristics examined, it is thought probable that they may have close genetic relationships, and might even be portions of the same fall, as the Caroline aerolite was found at the site of a blackfellows' camp, and had therefore possibly been transported from its original place of fall.

References

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