Kamacite plate width estimation in octahedrites

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Summary. Tables are given which enable a quick estimate to be made of the true thickness of kamacite plates from measurements of the Widmanstetter figure on a single random plane. The method is applied to the following meteorites (width in mm following name): Arispe, 2·90; Brenham, 0·91; Duketon, 1·13; Henbury, 0·74; Ogallala, 1·53; Thule, 0·89; View Hill, 0·62.

THE true width of the kamacite plates is an important property of the octahedrite group of meteorites. Although accurate methods for the determination of the true width from the apparent width are available they require either the study of more than one surface or the use of some method of determining the orientation of a single surface with reference to the plate pattern, such as that of Belaiew (1923). Since two surfaces are not always available and the single surface methods are somewhat tiresome it is not uncommon for published 'kamacite plate widths' to be the range of apparent widths on a random plane, a statistic of little value.

While examining contoured stereograms in an attempt to find a way of simplifying the exact calculations it was noticed that there was an approximate relationship between the maximum angle between adjacent directions of kamacite bands in the Widmanstetter figure and the angle of intersection between the surface and that set of plates most nearly normal to it. Further study showed that the relationship was sufficiently close to form the basis of a quick method of estimating the true width of the kamacite plates with an accuracy sufficient for most purposes.

It should be noted that the method is based on the assumptions that the kamacite plates are parallel to the octahedron and that they occur, and are of equal width, parallel to each face of the octahedron. If these assumptions are valid the method gives results with a maximum error of about 3 % (when in table I the correction factor is near 0·91) and an average error of about 1 %.

Method

On tracing paper placed over the Widmanstetter figure draw, through a single point, lines parallel to the directions of the traces of the kamacite plates. On the paper there will now be four, three, or two lines depending on the orientation of the plane with reference to the octahedral structure. If two lines diverging at ten degrees or less are mistaken for a single line the error introduced will usually be well under 3 %.

TABLE I. Correction factors when four sets of plates are observed

Max. angle	Factor	Max. angle	Factor	Max. angle	Factor	Max. angle	Factor
60°	0·97	68°	0·99	76°	0·95	84°	0·87
62°	0·97	70°	1·00	78°	0·93	86°	0·85
64°	0·98	72°	0·99	80°	0·91	88°	0·83
66°	0·98	74°	0·97	82°	0·89	90°	0·82

Four lines. Measure the largest angle between adjacent lines and look up the correction factor in table I. On the Widmanstetter figure select that set of plates having the least apparent width, measure the apparent width of sufficient plates to give the required accuracy. The average of these measurements multiplied by the correction factor is an estimate of the true width of the kamacite plates.

Three lines. Two of the angles will be the same or similar, the third different. Measure the third unique angle and look up the correction factor in table II. On the Widmanstetter figure select the two sets of plates that include the measured unique angle. Measure the apparent width of a convenient number of plates in each of the two sets and obtain the average apparent width of each of the two sets. The weighted mean of the two averages multiplied by the correction factor is an estimate of the true width of the kamacite plates.

TABLE II. Correction factors when three sets of plates are observed

Unique angle	Factor	Unique angle	Factor	Unique angle	Factor
10°	0·82	45°	0·88	63°	0·96
20°	0·83	50°	0·90	66°	0·97
30°	0·85	55°	0·92	68°	0·98
40°	0·87	60°	0·94	70°	1·00

Two lines. On the Widmanstetter figure measure the apparent width of a convenient number of bands in each of the two directions. Obtain the average width for each direction. The weighted mean of the two averages multiplied by 0·82 is an estimate of the true width of the kamacite plates.

Examples of results obtained are given in table III.

TABLE III. True kamacite-plate widths in several meteorites

	No.	Name	Angle	Factor	App. width (mm)	Width (mm)
Two directions						
	1	Henbury	—	0·82	0·90±0·19(24)*	0·74
Three directions						
	2	Brenham	64	0·96	0·95±0·25(31)	0·91
	3	Duketon	69	0·99	1·14±0·31(20)	1·13
Four directions						
	4	Arispe	67	0·985	2·94±0·55(10)	2·90
	5	Ogallala	68	0·99	1·55±0·30(7)	1·53
	6	Thule	72	0·99	0·90±0·13(6)	0·89
	7	View Hill	69	0·995	0·62±0·18(19)	0·62

* Mean, estimated standard deviation of widths and number of measurements.

Data from the following sources: (1) Spencer, 1951, pl. 13, fig. 1. (2) Nininger, 1952, pl. 17. (3) Personal specimen, see Frost, 1958 and 1965. (4) Mason, 1962, fig. 52. (5) Nininger, 1952, pl. 11, fig. 2. (6) Buchwald, 1961, fig. 3. (7) Specimen, University of Canterbury No. U.C. 4629.

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