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SHORT COMMUNICATION

Determination of the Orientation of Olivine Using the Electron-Microscope-Universal-Stage

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The orientations of individual crystallites in a fine structure were determined in the electron microscope by electron diffraction. The specimen was a synthetic forsterite sample from Aalesund, Norway. An inhomogeneous region in the porous rock consisting of an accumulation of pores around a solid core was examined. The electron microscope used was a Philips EM 300 with goniometer stage PW 6500/00. The goniometer is a two-axes universal stage which can be tilted about a horizontal axis and rotated azimuthally in the specimen plane. Angles of tilt up to $\pm 60°$ with respect to the microscope axis can be achieved.

In order to obtain the submicroscopic forsterite crystallites in their original orientation they were extracted from the polished and ultrasonically bombarded rock surface by means of a replica.

The orientation was determined by indexing the spots on a single crystal diffraction pattern as plane (uvw)* in the reciprocal lattice. Knowing the tilt and the azimuthal angles and the normals to these reciprocal planes, the zones [uvw] in the crystal lattice were plotted in a stereogram with the specimen plane as equatorial plane (reference plane). The orientation of each crystallite was determined from at least two zone directions.

Selected area electron diffraction and electron microscopy were carried out at the same time. The diameter of the selected area was 1.7 μm.†

†By using the beam from *one* reflection in the diffraction pattern of a selected zone direction, all the crystallites with this orientation can be observed simultaneously in the dark field.

An error of $\pm 7°$ in the orientation determination is due to: (1) measurement error caused by asymmetrical diffraction patterns, and (2) bending of the electron microscope specimen due to bending of the grid or sagging of the replica film.

The orientation determination shows that the normals to the rock surface approximate to a preferred orientation of [010]. In a section of this surface, the examined site is represented by an island (1.3 mm long, 0.7 mm wide) surrounded by a cavity. The [010] zone directions are scattered around the preferred orientation, or, in other words, they lie on the section of a girdle through the preferred orientation.

The orientation of known mineral crystals, as well as the modification of unknown crystals was determined with the goniometer stage by selected area diffraction on one individual grain. In order to obtain additional *d*-values the crystal was rotated, with the angle of tilt at its maximum possible value of 120°, and the diffraction spots from the traversed section of the reciprocal lattice were collected by continuous exposure. Having compiled a list of the corresponding *d*-values, the compound was then looked up in the FINK index. If the *d*-values obtained are insufficient for an identification, another diffraction pattern must be taken at a different azimuthal angle so the tilt axis will be disposed differently to the crystal. Crystalline components of mixtures present in *low* concentrations could not be detected by the powder method using electron radiation.