

with debris of altered sedimentary or gneissic rocks or with minerals derived from the disintegration of granite. It is possible that under the name of white mica not only muscovite and sericite, but other varieties, and also altered black mica, are included. Generally speaking, the micas are the less altered of the silicates of the deep-sea deposits.

**OLIVINE.**—Almost always irregularly-bounded grains, except when coated with volcanic glass; in this case olivine has the crystallographic forms of this mineral in recent eruptive rocks; often skeleton crystals. Imperfect cleavage following the brachypinakoid and cracks following the macropinakoid. Transparent, colourless, greenish or reddish by alteration, without pleochroism, and with feeble absorption, high relief; colours of polarisation very bright green and red, even for the smallest fragments. Numerous inclusions of fluid, of vitreous grains, of magnetite and picotite. Decomposes into serpentinous matter, but generally the alteration of olivine in deep-sea deposits is accompanied with a deposition of ferric oxide or hydrous oxide of iron. Gelatinises with sulphuric acid. Olivine is found in some exceptional cases with debris of crystalline schists or older eruptive rocks, but generally with clastic volcanic minerals and fragments of basalts, limburgite, tachylite, and in volcanic ashes.

**PYRITES.**—Sometimes observed in cubic crystals or in the form of pentagonal dodecahedrons, sometimes with the characteristic striæ of oscillatory combination, sometimes in irregular grains, opaque, yellowish metallic lustre or bluish black in reflected light. Occasionally transformed into limonite.

**PYROXENE.**—(a) *Rhombic*, lamellar aggregates, generally large fragments, are found with older eruptive rock debris, short prismatic fragments with products of more recent eruptions. Cleavage following the prism of about  $90^\circ$ , in some cases also another cleavage parallel to the brachypinakoid. Index of refraction high, low interference colours. Extinction parallel to the pinakoidal cleavage. *Enstatite*, colourless to grey, yellowish, not pleochroic. *Bronzite*, often fibrous, yellowish to greenish, pleochroic, greyish green, yellowish. These two pyroxenes often contain metallic inclusions, intergrowth with monoclinic pyroxene. Associated with older rock debris, principally with peridotite rocks, and with volcanic ashes of andesitic or trachytic nature. In this case the fragments or crystals have often glass inclusions, but do not show intergrowth with monoclinic pyroxene. This or the previous variety found also in cosmic spherules. *Hypersthene*, greenish, red or brownish fragments bounded by cleavage planes, prismatic when associated with the debris of more recent eruptive rocks, intergrowth with monoclinic pyroxene. In the massive variety characteristic tabular inclusions, strong pleochroism. Found rarely with debris of older eruptive rocks, in some cases with lapilli or minerals of andesitic or trachytic eruptions.

(b) *Monoclinic.*—*Augite*, fragments irregularly bounded or with cleavage planes, often crystals of the ordinary form, coated with volcanic glass, twinning parallel to the orthopinakoid, cleavage parallel to the prism of  $87^\circ 6'$ , greenish, yellowish, brownish, purplish, high index of refraction, strong double refraction, oblique extinction of  $36^\circ 54'$ . Weak pleochroism: green, yellow, brown; in some cases not pleochroic. Gaseous or glassy inclusions frequent, encloses also crystals and grains of magnetite. Found frequently in the deposits with debris of basalts, andesites, &c., in volcanic ashes. *Diallage*, grains bounded by cleavage faces, cleavage parallel to the orthopinakoid, fibrous structure; greenish or brownish, tabular inclusions, double refraction strong, maximum extinction angle of about  $40^\circ$ , cleavage plates show one of the systems of polar rings. Associated with debris of older eruptive rocks.

**QUARTZ.**—It is generally in the form of quartz that free inorganic silicic acid is found in the deposits; particles of jasper, chalcedony, &c., are relatively rare. Only in exceptional instances was quartz observed as small crystals bounded by the planes of the hexagonal prism and pyramid. As a general rule the grains of this mineral are without any crystallographic outlines; they are angular or rounded, massive, without cleavage planes, with a characteristic conchoidal fracture. After cleaning with acid, the grains are transparent and colourless; some are clouded with inclusions, no traces of alteration, not attacked by acids. The latter characters: absence of cleavage planes, conchoidal fracture, rounded or angular form, without crystallographic faces, absence of any decomposition, distinguish at first sight this mineral from felspar. Interference figure of monaxial crystals, positive double refraction, in parallel polarised light bright colour, when the fragments attain, as they do in some deposits, a certain thickness. In many cases this mineral is characterised by its inclusions, sometimes arranged in planes or irregularly disposed, by liquid inclusions, some with carbonic acid or with small cubic crystals; sometimes these quartz grains contain needles of tourmaline, rutile, scales of