hematite, chlorite, &c. The minerals associated with the quartz grains give a clue as to the matrix rock: quartz fragments derived from granite are generally characterised by numerous liquid inclusions, some with cubic crystals, the grains have not crystallographic outlines. The same may be said of quartz derived from crystalline schists. Quartz of porphyritic rocks, which is very rare, is distinguished in some rare cases by its more or less regular outlines, corrosion, and by glassy geometrical inclusions; moreover, liquid inclusions are not so often met with as in granitic quartz. The quartz of clastic rocks is angular or rounded, the microstructure of the grains being the same as that of the same mineral in the rocks in which it was originally formed. *Vein quartz* presents irregular grains or aggregations of grains containing numerous liquid inclusions, sometimes fibrous or milky. Fragments of *chalcedony* are fibrous with a radiated structure, the fibres being very thin; double refraction negative, aggregate polarisation or spherulitic interference cross.

The silica derived from organic remains, which, like quartz, plays a very important part in marine deposits, behaves, between crossed nicols, like an isotropic body; to this character must be added the property which this variety of silica possesses of preserving, notwithstanding its tenuity or disaggregation, a special organic structure (Radiolaria, Diatoms, Sponge spicules). This structure enables us in numerous cases to determine the organisms from which the siliceous particles are derived. This variety of silica is soluble in caustic potash.

Rutile.—This mineral is very rarely found in isolated prismatic crystals or in small grains, it is generally imbedded in fragments of rocks. In some shore deposits rutile is observed in the form of fine needles, or fragments of microscopic prismatic crystals often twinned as in the slates. Sometimes these small crystals are arranged in groups (*sagenite*), brown or reddish in colour. Double refraction very strong, high relief and brilliant polarisation colours for the smallest particles, not acted upon by acids. Associated with debris of older schisto-crystalline rocks, slates, &c.

Serpentine.—Compact or fibrous grains, in some cases mesh- or lattice-structure, yellowish, greenish, or brownish; in the veins, secondary deposition of metallic oxides; remains of the primitive mineral imbedded in the serpentine, birefrangent, colours of chromatic polarisation generally weak; in polarised light the fibrous or special structure appears most distinctly. Attacked by hot hydrochloric acid, and by sulphuric acid, with separation of gelatinous silica.

Tourmaline.—Often found in small prismatic fragments or hemimorphic crystals. Transparent, brownish, bluish grey, reddish or greenish. Strong pleochroism, the ordinary ray very much absorbed, extinction parallel to the length, no cleavage but cracks somewhat parallel to the base, tolerably numerous inclusions often grouped together. Unattacked by ordinary acids. Almost always associated with debris of crystalline schists, granitic rocks, slates, &c.

Zeolites.—Sometimes granular aggregations, isotropic (*analcim*), or with rhombohedric cleavage (*chabasite*), more frequently divergent or radiated aggregations of small prismatic crystals, exceptionally isolated crystals or fragments of crystals bounded by prismatic and pyramidal faces, generally attached to fragments of rocks or of volcanic glass; colourless, transparent, low polarisation colours. Easily acted upon by hydrochloric acid, with formation of gelatinous silica. It was only possible in some exceptional cases to give a specification of the various zeolites, by microscopical examination or by microchemical reactions (see chapter on formation of zeolites in the deep-sea deposits).

Zircon.—Small quadratic crystals more or less rounded, prismatic but generally short, with indications of pyramidal faces. Colourless, yellowish, reddish, strong double refraction, relief very marked, colours of polarisation bright red and green, no pleochroism. Sometimes zonary structure, liquid and other inclusions. Reaction for zirconia by fusing with bicarbonate of soda. Found with debris of crystalline schists and of older and recent eruptive rocks, associated also with quartz grains, and other minerals derived from the disintegration of sedimentary rocks.

The above are the minerals most frequently met with in the deposits, and the microscopical characters on which we rely for their determination. It is true that all the characters used in lithological investigations are not indicated in the foregoing short