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Zeolites and other minerals from Dean quarry, the Lizard, Cornwall

THIS is a preliminary account of an interesting occurrence of minerals in the Lizard. Dean quarry is adjacent to Dean Point, two miles NE. of Coverack on the east coast of the Lizard peninsula, Cornwall, and is situated on the large intrusion of gabbro that extends northwards from Coverack to St. Keverne, and from Manacle Point in the east to Trelan in the west. The gabbro and its petrography have been described in detail in the Geological Survey's memoir[1] on sheet 359. The major part of the gabbro in this quarry is of the type described as 'grey-green' or 'flaser' gabbro in the memoir, but it varies in texture from schistose to pegmatitic.

The author has visited the quarry from time to time during the last fifteen years and found nothing of unusual mineralogical interest, except for some remarkably coarse gabbro pegmatite, with pyroxene crystals up to 25 cm in length, or appreciably longer than the largest recorded in the Lizard memoir. During a visit in 1967 zeolites and other minerals were found. High on the quarry face, quite out of reach, was a circular patch of white crystals, about 50 cm in diameter and slightly concave, which suggested it might have formed part of a geode. Eventually some specimens were discovered among the debris formed by blasting.

The most prominent of the zeolites is analcime, which occurs in trapezohedra, {211}, up to 4·5 cm in diameter. It is usually white, but sometimes stained brown. Most of the white crystals are translucent, but a few are sub-transparent. The {100} cleavage is often fairly well developed.

The analcime is frequently accompanied by natrolite up to 4 cm in length, in the form of closely packed divergent groups or separate euhedral crystals. The natrolite is prismatic to acicular in habit; in some crystals the prism {110} is terminated by {111}. These crystals are much finer than any the author has seen from Chynhalls Cliff, south of Coverack, an occurrence of natrolite in the Lizard that has long been known.

[1] J. S. Flett, *Geology of the Lizard and Meneage*, 2nd edn, 1946.

Prehnite is also present, but in much smaller quantities than analcime and natrolite. The prehnite is very pale green and has the characteristic radial columnar structure and reniform or somewhat ridged crystalline surface.

Colourless calcite is fairly plentiful. Some crystals have brilliantly reflecting faces and are highly transparent, but others are translucent. The crystals range up to 1 cm or a little more in length and are often rich in forms. The habit is essentially rhombohedral, dominated by $\{02\bar{2}1\}$, with the scalenohedron $\{13\bar{4}2\}$ subsidiary. One crystal possessed the forms $\{02\bar{2}1\}$ and $\{13\bar{4}2\}$, combined with smaller faces of $\{0001\}$, $\{10\bar{1}1\}$, and $\{40\bar{4}1\}$ and quite small faces of $\{07\bar{7}1\}$, $\{44\bar{8}3\}$, and a positive scalenohedron, which it was not possible to determine with certainty. Additional forms are present on other crystals.

Pale brown crystals of calcite are present on the surface of the prehnite. They are simple rhombohedra $\{02\bar{2}1\}$, often with drusy surfaces, which appear to have been formed at a different period to the colourless calcite.

A sequence of deposition can be determined for most of the minerals. Although few specimens have been collected *in situ*, it is evident that many of the minerals occur in veins, in which zoning and superposition give indications of the paragenesis. Colourless calcite may occur alone in the veins, or form a lining to veins that contain analcime in the centre. When natrolite is present with analcime it rests upon the latter. It is not yet possible to place prehnite in this sequence with much precision; deposition of the colourless calcite seems to have preceded the prehnite, but the brown calcite succeeded it. Prehnite has not yet been observed in contact with analcime. In two specimens prehnite and natrolite occur together, but their relative ages are not clear. It seems likely that natrolite was formed after the prehnite, but this is not proved.

The origin and mode of occurrence of the zeolites and associated minerals cannot be established with certainty at this stage, but some evidence is available. Apart from the 'geode' of analcime mentioned earlier, natrolite has also been found *in situ*. It occurred in a vein in a region traversed by a system of parallel fractures, which appeared to be faults, so the vein of natrolite probably occupied a fault fissure. Many of the specimens that are found after blasting also seem to be in the form of veins. Thus the 'geode' of analcime was probably a remnant of a vein. The author's unpublished work on the serpentinite of the Lizard peninsula gives evidence of widespread hydrothermal activity *after* serpentinization. It is therefore tentatively suggested that the formation of analcime, natrolite, prehnite, and calcite may be genetically connected with this period of hydrothermal activity.

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