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Al-free gyrolite from the Lizard, Cornwall, England

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ABSTRACT

Gyrolite containing no detectable Al (<0.04 wt.%) has been found as aggregates of platey crystals to 6 mm at Dean Quarry, the Lizard, Cornwall. The gyrolite occurs embedded in calcite which fills a fracture vein in gabbro. Paragenetic evidence is inconclusive, but suggests that gyrolite formed relatively early, after prehnite, and possibly around the same time as analcime and natrolite.

KEYWORDS: zeolite, gyrolite, Lizard, Cornwall.

GYROLITE, $NaCa_{16}Si_{23}AlO_{60}(OH)_8 \cdot 14H_2O$, was first discovered by Anderson (1851) on the Isle of Skye. The mineral occurs as a hydrothermal alteration product in basic igneous rocks and has been found subsequently at several other locations in Scotland and numerous localities worldwide (e.g. Anthony *et al.*, 1995). Gyrolite has now been identified (by FTIR and EDX spectroscopy and XRD) on a single specimen from Dean Quarry, St Keverne, The Lizard, Cornwall, England (NGR SW 803203).

Dean Quarry lies in the Devonian Crousa gabbro. The gyrolite described here was collected in 1975 in the 'old' quarry. This part of the workings was abandoned around 1982, but quarrying continues at Dean Lowland quarry, situated a few hundred metres to the south. Gyrolite occurs as several rounded groups of platey crystals to 6 mm across, embedded in anhedral white-colourless calcite which fills a narrow fracture vein in the host gabbro. The gyrolite crystals are translucent, colourless to very pale ocherous-brown with a distinctive pearly lustre. The gabbro at the vein boundary is enriched with plagioclase.

Semi-quantitative EDX analysis (Table 1) shows the gyrolite to contain no detectable Al (<0.04 wt.% Al). Al is not essential to the gyrolite structure and indeed, Al-free gyrolite has been

TABLE 1. EDX analysis of gyrolite from Dean Quarry and ideal composition

	1	2
Si	25.67(25.18–26.33)	24.06
Al	<0.04	1.00
Ca	24.17(23.91–24.44)	23.88
Na	0.62(0.56–0.69)	0.86
O	49.54	48.86
H		1.34
Total	100.00	100.00

1. Gyrolite from Dean Quarry. Average of analyses on 6 grains. Range shown in parentheses. EDX conditions 15 kV, 2×10^{-9}A. Al not detected, limit of detection ~0.04 wt.%. Oxygen determined by difference.
2. Gyrolite ideal composition: $NaCa_{16}Si_{23}AlO_{60}(OH)_8 \cdot 14H_2O$, Merlino (1988).

synthesised. However, limited substitution for tetrahedral Si is normally expected and Merlino (1988) regards the existence of naturally occuring Al-free gyrolite as improbable. A wealth of analyses support this view (Merlino, 1988, and references therein). However, Sukheswala *et al.* (1974) report natural gyrolite from the Deccan Traps near Bombay, India, which apparently contains no Al, and the specimen from Dean quarry reported here provides a second example. FTIR data for the Dean quarry gyrolite are very similar to those published by Gard *et al.* (1975). XRD data were obtained by diffractometry and inevitably show considerable preferred orientation, but *d*-spacings agree well with published values.

The occurrence and sequence of formation of zeolites and associated minerals at Dean quarry has been described in detail by Seager (1969, 1971). Gyrolite is later than the calcite in which it is embedded, or perhaps contemporaneous with the late stages of calcite formation. Unfortunately, there are no minerals associated with the gyrolite other than calcite and consequently gyrolite cannot be located with certainty in the paragenetic sequence at Dean quarry.

Seager (1971) recognised several generations of calcite and prehnite at Dean quarry, each with characteristic colours and crystal habits. An early part of the sequence, before (or possibly overlapping) the appearance of early zeolites (analcime and natrolite) is white/colourless prehnite (massive or tabular crystals), pectolite (white fibrous radiating masses), and white/colourless calcite (vein filling). Specimens illustrating this sequence have been collected recently from the upper benches of Dean Lowland quarry, occuring as narrow veins in gabbro. The generation of calcite involved in this association is very similar to that enclosing the gyrolite. Seager (1978) suggested the use of fluorescence and phosphorescence to characterise early and late calcites in the Lizard. Examinination of numerous specimens from Dean Quarry suggests that there may be some merit in this approach and supports the view that the calcite associated with the gyrolite is of an early generation. It therefore seems reasonable to conjecture that gyrolite was formed around the same time as analcime and natrolite, i.e. after prehnite, but earlier than the late zeolites, stilbite, heulandite and chabazite. In the laumontite zone of the western Deccan Traps, Bombay, India, Sukheswala (1975) found gyrolite with calcite and other relatively late-crystallising minerals upon a foundation of earlier prehnite. The hydrothermal solutions responsible for the formation of gyrolite may have become depleted of Al by the earlier deposition of prehnite, providing a possible explanation for the unusually low Al content of the gyrolite both in this location and at Dean Quarry.

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