Note–*Notis*

Smectite formed as a weathering product of granite at Holmsbu, southern Norway

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X-ray diffraction and chemical analysis of fractions of weathered Permian igneous rock of an alkali granite showed the occurrence of a weathering product rich in a smectite of the beidellite type.

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Introduction and methods

Clay minerals of the smectite group developed in bedrocks have been identified at several localitites in Norway (see e.g. Barth 1939, Dahl 1954, Gjems 1967, Hagemann & Spjeldnæs 1955, Isachsen & Rosenqvist 1949, Jørgensen 1964, Låg 1945, 1948, 1963, Roaldset 1972, 1978, Rosenqvist 1957, 1959, Sæther 1964).

The sample investigated is a product of weathering in a Permian igneous rock of an alkali granite, collected at Holmsbu on Dramsfjorden, about 50 km south of Oslo. The sample had a light grey colour (2.5 Y 7/0) and was taken at a depth of 1 m in a wooded area.

The three fractions <37 μm, 63–74 μm, and <74 μm were separated by dry sieving, and the clay fraction (<2 μm) by sedimentation.

The preparation of the fractions for X-ray diffraction was undertaken using a procedure described by Gjems (1967).

The total content of Si, Al, Fe, Mg, Ca, and K was determined by X-ray fluorescence spectrometry.

The contents of exchangeable Na^+, K^+, Mg^{2+} and Ca^{2+} were determined by atomic absorption after they had been extracted by a sufficient excess of 1 M NH_4OAc (pH = 7.0).

The pH was measured in water suspension (1:10).

Results and discussion

The basal spacing at about 15 Å in the Mg^{2+}-treated, air-dried fractions expands to 17.7 Å by ethylene glycol treatment, and collapses to 10 Å by heating at 550°C (Fig. 1).

A very small peak for 10 Å appears for the fraction <37 μm and a somewhat bigger one for the fraction 63–74 μm in the Mg^{2+}-treated, air-dried form. This peak, however, cannot be observed in the diffractogram for the clay fraction.

The diffractograms seem to show that smectite is the dominating clay mineral group in the fractions investigated. The relatively low content of Mg and Fe, and high content of Al in the fractions analysed (Table 1) indicate that the smectite is of the beidellite type. The Al content, however, belongs partly to the feldspars present. The considerable expansion to 17.7 Å by ethylene glycol treatment indicates that the smectite has a low charge density.

Illite could not be identified in the clay fraction. The diffractograms seem, however, to indicate that the coarser fractions investigated contain small amounts of this mineral.

The diffractograms of the fraction <37 μm and 63–74 μm show the occurrence of some quartz and feldspars, mostly alkali feldspar.

The clay fraction seems to contain only traces of feldspars and consists predominantly of smectite.

Relatively small amounts of the Al and some of the Fe in the fractions were extracted by the citrate/dithionite treatment during the preparation for X-ray diffractometric investigation (see Table 1).

The fraction <74 μm contained 0.3 meq. Na^+, 0.9 meq. K^+, 11.2 meq. Mg^{2+}, and 29.2 meq. Ca^{2+} per 100 g in exchangeable form, and has

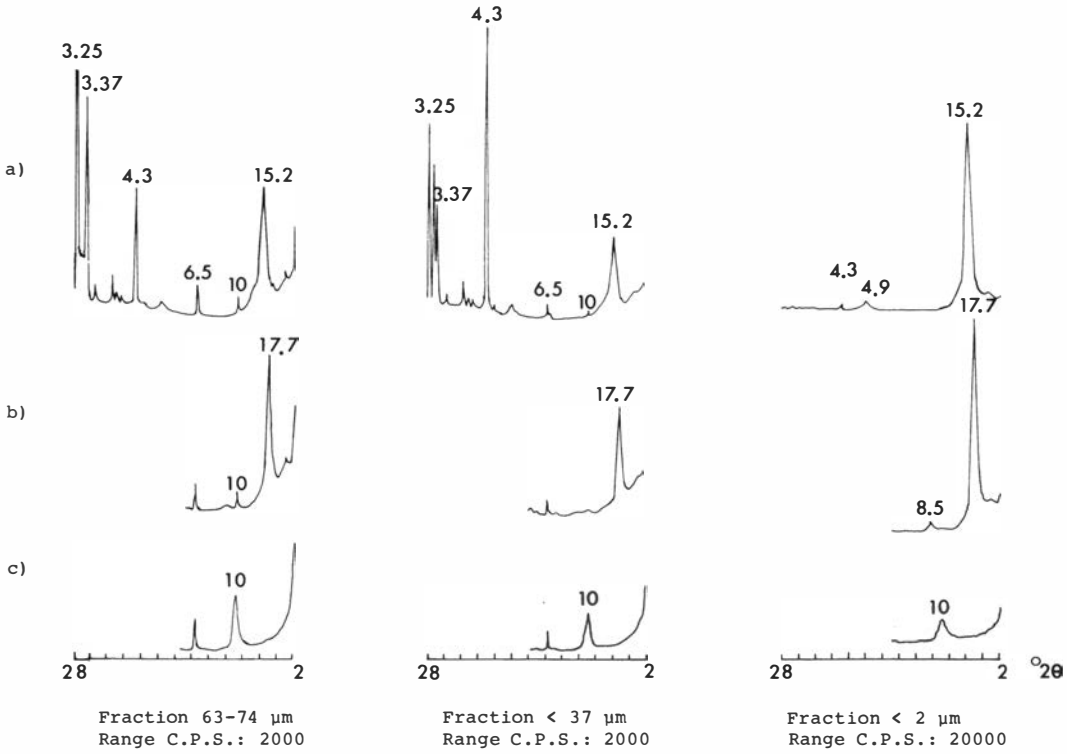

Fig. 1. Diffractograms of different fractions. a) Mg^{2}-treated and airdried, b) Treated with ethylene glycol, c) heated by 550°C.

consequently a relatively high cation exchange capacity, according to the high content of smectite.

The pH of a suspension of 1 g of the fraction <74 µm in 10 ml H_2O after shaking and standing over night in a closed sample glass was 7.8.

The absence of illite in the clay fraction and its presence in the coarser fractions investigated may indicate that most of the mica is converted to smectite. In addition it seems that also feldspars have weathered to smectite. In north-east Scotland, Wilson et al. (1971) observed that, with the exception of microcline, all feldspars in a deeply weathered granite and granulite boulder conglomerate had weathered completely to a cheto-type montmorillonite, poor in iron. For a long time it has been thought that the formation of smectite during weathering is favoured by an alkaline environment with retention of alkaline earths and silica (Keller 1957).

The chemical weathering processes of the granite at Holmsbu may have taken place over a long time, e.g. during the Tertiary period, while the mechanical break down of the bedrock is of post-glacial age, as supposed for the occurrence at Kjose, Vestfold (Låg 1945, 1948).

Tab. 1. Total content (g/100 g ignited sample at 900°C) before and after citrate/dithionite treatment of the fraction <37 µm.

	SiO_2	Al_2O_3	Fe_2O_3	K_2O	CaO	MgO
Before treatment	70.3	15.6	1.1	6.3	1.2	1.2
After "	-	14.3	0.6	-	-	-

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