

arranged access to the outcrops and drill cores, and provided maps and information on the area.

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Composition of some Aluminium Silicate Bearing Contact Rocks from County Donegal, Eire

THE wide occurrence of the three aluminium silicate minerals andalusite, kyanite and sillimanite either individually or in pairs, or sometimes all together in metamorphic rocks^{1,2}, makes the study of these minerals attractive to petrologists and experimentalists because their presence and associations may be used to delineate the temperature and pressure range of a given metamorphism.

The aureoles associated with the granite plutons of Donegal³ present a unique opportunity for a study of these polymorphs in the field, particularly because the Donegal area has been investigated in great detail by many workers⁴. The aureoles contain all the polymorphs in various combinations and previous workers in this area have regarded the presence of a particular aluminium silicate or association of the polymorphs to indicate certain limits to the pressure operating during metamorphism. For example, the presence of kyanite in the deformed aureole of the Main Donegal Granite has been taken² to indicate that high pressure prevailed. Some undeformed aureoles, which carry andalusite, were thought in contrast to have formed at lower pressures. The role of rock composition was not seriously considered, although Pitcher and Read did suggest that andalusite may be confined to pelites of a particular composition.

Analyses of eighty aluminium silicate bearing pelitic rocks from five of the Donegal aureoles⁵ show a remarkable distribution with regard to the aluminium silicates present (Fig. 1). Kyanite-containing rocks have a restricted bulk composition. This mineral is limited to those rocks with magnesium/magnesium+iron ratios greater than about 0.5, while rocks containing andalusite, fibrolite and sillimanite in all possible combinations have unrestricted compositions within the compositional range studied.

Further, new textural and spatial data on the minerals from different aureoles clearly show that the crystallization sequence is kyanite, andalusite, fibrolite, coarse sillimanite⁵. These data are interpreted in terms of a series of overstepping reactions which take place with increasing temperature. The reactions are continuous and no reaction occurs between earlier and later aluminium silicates, all of which develop directly from the ground-mass. The presence of more than one polymorph in the same rock is therefore the result of metastable persistence. Not all the rocks show the whole sequence and individual aureoles or parts of an aureole may show only the assemblages formed by one of the reactions.

The first reaction produces kyanite in the relatively magnesium-rich rocks of the Ardara and the Main Donegal Granite aureoles and staurolite in the iron-rich rocks; these latter do not contain kyanite. Later reactions in all the rocks can produce andalusite, fibrolite and sillimanite; they do not involve the formation of an iron-rich phase such as staurolite and occur in rocks showing the whole range of magnesium-iron values found. The

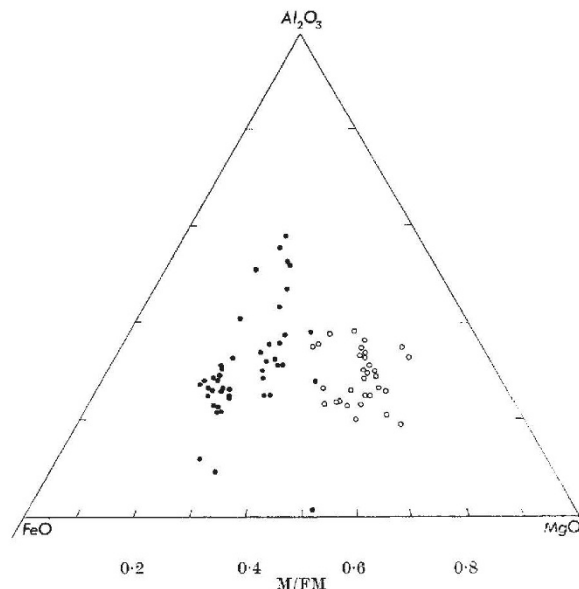


Fig. 1. Thompson AFM diagram of aluminium silicate bearing aureole rocks from County Donegal, Eire. ●, Kyanite free rocks; ○, kyanite bearing rocks.

actual assemblages seen in a given aureole are complicated by the overstepping which may be marked or limited, depending on the heating characteristics of that aureole. The first reaction is particularly prone, as one might expect, to considerable overstepping so that in the extreme case the assemblages of the first reaction have been found in only one or two rock samples of a particular aureole.

It may be concluded that the absence of kyanite in some or part of one of the Donegal aureoles may be caused by (1) the lack of an appropriate rock composition—indeed, few pelites have the high M/FM ratio required; (2) the fact that the reaction producing kyanite was overstepped.

Either or both of these factors will result in rocks not containing kyanite, in spite of the fact that the rock may have crystallized in or passed through the stability field of kyanite. In contrast, the absence of sillimanite or fibrolite or andalusite in the Donegal aureoles usually results from the lack of the appropriate physical conditions.

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Experimental Conversion of Biotite to Hydrobiotite

THE weathering of biotite in the soil frequently leads to replacement of interlayer K^+ by hydrated Mg^{2+} , with accompanying structural expansion along the c crystallographic axis from 10 to 14 Å (ref. 1). Usually, the 14 Å vermiculite phase becomes established without the development of well-defined intermediate spacings on the X-ray