



The fate of graphite in prograde metamorphism of pelites: an example from the Ballachulish Aureole, Scotland

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Graphite-bearing slates and phyllites (0.4 – 1.2 volume % graphite) are progressively metamorphosed in the 3 kbar aureole of the 425 Ma Ballachulish intrusion, Scotland. Two major dehydration reactions are crossed: the chlorite-out reaction at ca. 550 °C (forming cordierite+biotite), and the muscovite-out reaction at 625 °C (forming Al_2SiO_5 +K-feldspar). Graphite persists to the highest grades and shows no significant variation in abundance with grade, except for a possible decrease in the highest grade rocks (Zone V). Variable graphite abundance in rocks at the same grade reflects primary sedimentological heterogeneity. Texturally, graphite grains and aggregates in the rock matrix become coarser grained and more widely separated as grade increases. These thermally-induced textural modifications of graphite are superimposed on mechanically-induced features, such as graphite segregations along cleavages and crenulations, that formed prior to contact metamorphism. Mass balance modelling, assuming internal fluid generation, shows that the amount of graphite consumed during contact metamorphism in the aureole ranges between 0.1 and 0.3 vol %, depending on the amount of chlorite and muscovite in the protolith. Because the amount of C dissolved in a C-O-H fluid decreases with increasing pressure, and the Ballachulish aureole is at relatively low pressure, these results are a maximum for regional metamorphism, suggesting that graphite will persist through a regional metamorphic cycle if it is initially present in volumes > ca. 0.2 vol %.