SKARN GARNETS FROM SOUTH-WEST ENGLAND

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Chemical analysis of garnets from skarns in south-west England has revealed that they are all grandites, containing at least 90% of the grossular and andradite components. However, garnet compositions exhibit large differences in these components, from Gr_0And_{98} to $Gr_{82}And_{10}$, and this large range is also seen within discrete zones in individual crystals. There appears to be no clear distinction in chemical composition between garnets formed in a calcareous protolith compared to those in a basaltic protolith. It is therefore proposed that garnet composition is a function of fluid parameters and growth processes. High concentrations of tin in some samples demonstrate that this element was present in metasomatic fluids emanating from the granite before the advent of mainstage tin mineralization.

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INTRODUCTION

Garnets occur in several geological settings in south-west England, yet detailed descriptions are typically brief and they are poorly characterised. By far the most common setting for these garnets is in contact metamorphic environments, in close proximity to the granites. These environments can best be described as skarns, formed from contact metamorphism and additional chemical modification by the influx of hydrothermal fluids from the granites (metasomatism).

Although most previous studies have described such skarn garnets as part of the grossular-andradite series, relatively few chemical analyses have been presented to support this assertion. Furthermore, the few available analyses are typically of 'bulk' samples and by classical 'wet' chemical methods. These analyses suffer because they could be influenced by the presence of admixed mineral inclusions and, additionally, are not able to distinguish any small-scale chemical variations that may be present. The aim of this study is to characterize these skarn garnets through chemical analysis. From the results it may be possible to determine the controls on garnet composition, assessing the relative importance of the nature (chemical composition) of the protolith versus the chemical composition of the metasomatising, granitic fluids.

SAMPLES AND METHODOLOGY

Most of the important garnet occurrences have been sampled for this study (e.g., Collins, 1871). Samples have been collected by the author and supplemented from collections at Royal Holloway, the University of Keele and the British Geological Survey (BGS) (see Table 1). The BGS material is particularly valuable as it includes both exploration drill core and samples collected in the 19th Century from locations that are no longer readily accessible (e.g., Figure 1a).

In SW England, skarn garnets have commonly formed by alteration of both basic, igneous lithologies ('greenstones') and calcareous sediments. The development of skarns in calcareous sediments (carbonates) is a common phenomenon worldwide, but skarns in basic volcanic lithologies are rather more unusual.

Calcareous sediments are present at various locations in both Devon and Cornwall. Regional and contact metamorphism has converted these impure limestones to a compact, relatively fine-grained (flinty), calc-silicate assemblage known locally as 'calc-flinta' (e.g., Phillips, 1964). However, at some locations close to the granites, metasomatism has superimposed a new, coarser grained, calc-silicate assemblage, containing a wide array of new minerals and often including garnet. The Lower Devonian Meadfoot Beds of Central Cornwall, which occur north and east of the St Austell granite, contain several calcareous units which have experienced metamorphism and many such (skarn) locations were previously exposed in roadstone quarries (Barrow and Thomas, 1908; Ussher *et al.*, 1909). In addition, exploration for tin mineralization in the area north of the St Austell granite during the last few decades resulted in a large number of drill cores that intersected these calcareous units; some of these are now lodged with the BGS and thus are available for study.

Calcareous sediments are also abundant in the Lower Carboniferous strata of Devon. Metamorphic calc-silicate assemblages are well-developed both at the southern margin of the Dartmoor granite in the South Brent to Ivybridge area (Barrow, 1912; Busz, 1896, 1901; Fitch, 1932), and in limestone-chert units to the north of the Dartmoor granite in the Okehampton region (Edmonds *et al.*, 1968; Dearman, 1962; El Sharkawi and Dearman, 1966).

Basic volcanic rocks ('greenstones') consisting of basaltic sills and lava flows are particularly abundant in west Cornwall. They are well-exposed in the contact metamorphic aureoles adjacent to the Lands End granite (Floyd, 1965; van Marcke de Lummen, 1985; Jackson and Alderton, 1974; Alderton and Jackson, 1978) and to the north of the Carnmenellis granite, in the Camborne – Redruth mining district (Hill and MacAlister, 1906).

Some notable garnet occurrences are also found in uncertain geological settings. The Haytor iron mine formerly exploited magnetite from a predominantly magnetite and amphibole