A NEW RHODONITE OCCURRENCE IN THE CASSIAR AREA, NORTHERN BRITISH COLUMBIA (104P/5)

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KEYWORDS: Economic geology, rhodonite, Sylvester allochthon, stratabound, syngenetic.

INTRODUCTION

Several occurrences of rhodonite in float and subcrop in the Cassiar map area (104P/5) were reported by Nelson *et al.* (1989). This note reports the discovery of a bedrock rhodonite deposit by Z.D. Hora during follow-up prospecting in July 1989, which has significant potential as a source of carving-quality material. The deposit is located at the headwaters of Snowy Creek 4 kilometres north of the Stewart-Cassiar Highway (Figure 2-15-1).

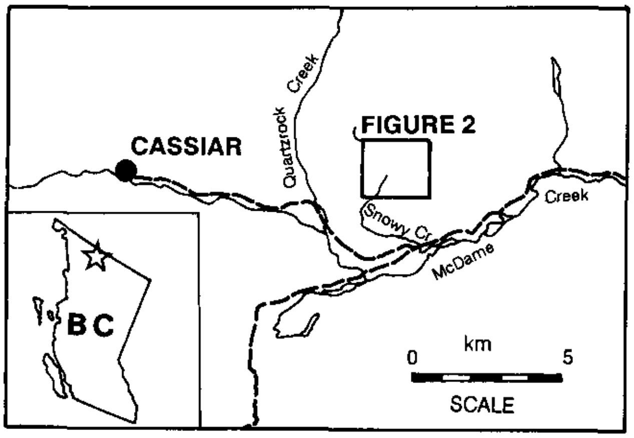

Figure 2-15-1. Location of Snowy Creek rhodonite deposit.

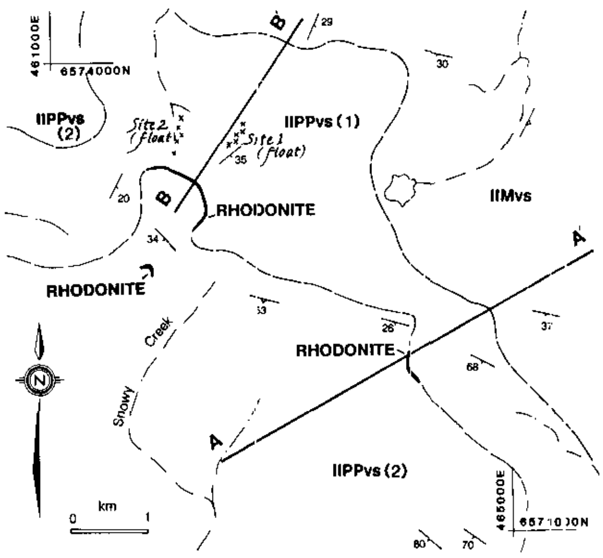

Figure 2-15-2. Simplified geologic map showing area of rhodonite horizon. IIMvs: Mississippian basalt and siliciclastic to pelagic sediments and diabase sills. IIPPvs (1): Pennsylvanian to Permian drab cherts, argillites; basalt and diabase. IIPPvs(2): Pennsylvanian to Permian brightly coloured chert, argillite; basalt, diabase.

GEOLOGIC SETTING

The Snowy Creek rhodonite is both stratiform, albeit poddy, and stratabound. It occurs within unit IIPPvs of the Sylvester allochthon (Nelson and Bradford, 1989), a Pennsylvanian-Permian sequence of well-bedded chert and argillite, interbedded basalt and abundant diabase sills. More specifically, the rhodonite is located above a section of grey, black and pale green chert and argillite at the base of the unit [IIPPvs(1) on Figure 2-15-2] and about 50 metres below an upper section of brightly coloured, maroon, red, green and grey chert and argillite [Unit IIPPvs(2) on Figure 2-15-2]. This stratigraphic position holds over at least 4 kilometres strike length, as shown by the two cross-sections in Figure 2-15-3. The immediate host of the rhodonite is well-bedded grey to pale green radiolarian chert with argillite partings.

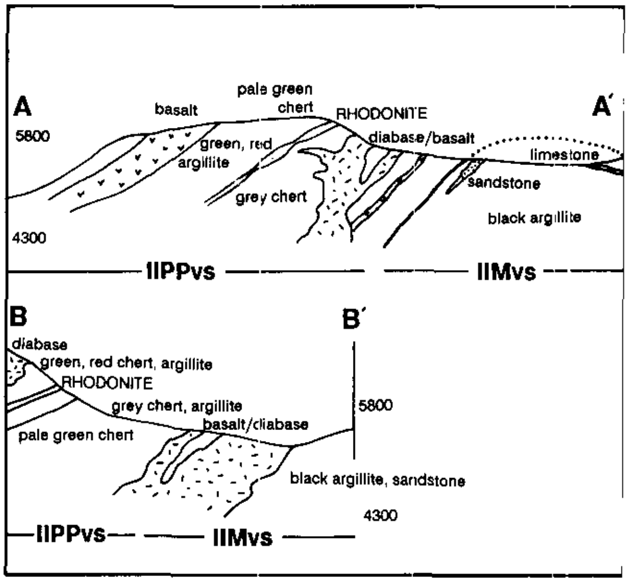

Figure 2-15-3. Cross-sections through rhodonite horizon.

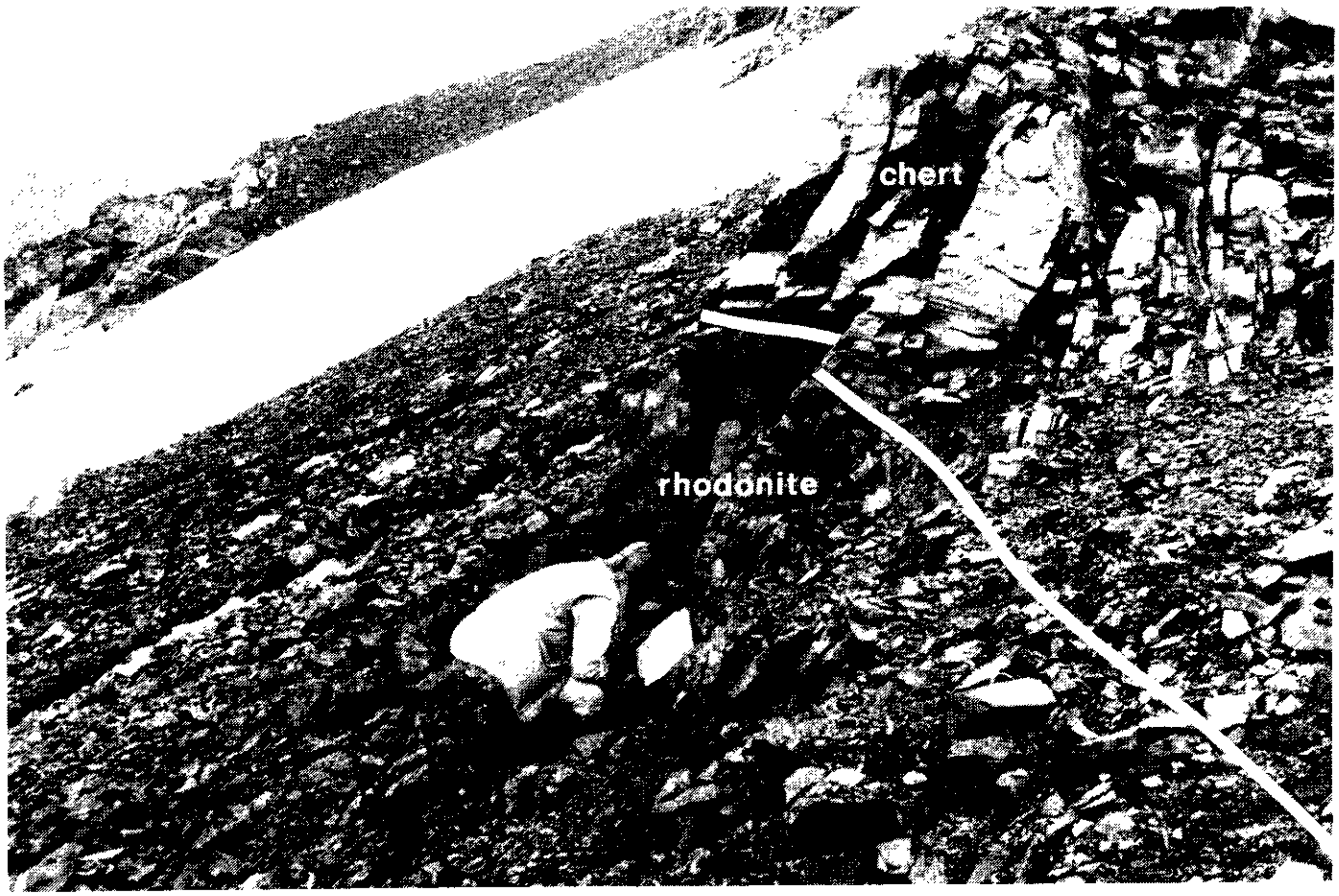

Plate 2-15-1. Outcrop of Snowy Creek rhodonite.

DESCRIPTION OF DEPOSIT

The Snowy Creek rhodonite is a bedded lensoidal sequence that ranges in thickness from zero to 5 metres. It forms a prominent soot-black-weathering outcrop that partly encircles one of the summits at the headwaters of Snowy Creek (Plate 2-15-1). A continuation of the rhodonite horizon was seen in a cliff 4 kilometres to the southeast. Between these two localities extensive diabase sills interrupt the continuity, although the possibility of making further discoveries is good.

An example of this untested potential is shown by the occurrence of rhodonite in float at Site 1 (Figure 2-15-2). There, scattered angular fragments and boulders are found along the small stream that flows northeast from the pass north of the main showing. The size of the fragments suggests a bed at least 70 centimetres thick. The fragments are scattered over 250 metres, their distribution suggesting an unrecognized source in the cliffs to the southeast. Rubble from two large rock-slide scars in the upper parts of these cliffs partly covers the rhodonite float. It is therefore assumed that the bedrock source is in the lower part of the cliffs.

The main deposit consists of three isolated outcrops each 200 to 300 square metres in exposed area, and ranging up to 100 metres of strike length (Figure 2-15-2). The outcrops consist of approximately 20 metres of grey-green chert with an enclosed rhodonite zone up to 5 metres thick, although abruptly pinching to zero thickness. Slightly different elevations of the various pods may result from a mildly transgressive style of mineralization, or from small displacements on vertical faults. Site 2 rhodonite float is derived from the main outcrop area.

The easternmost outcrop of rhodonite has a footwall and hangingwall of blood-red ferruginous chert. The rhodonite is associated with light yellow chert, which occurs as discrete layers, irregular patches and massive lenses up to 10 centimetres thick. The texture of the rhodonite varies from laminated to patchy. Massive rose-pink rhodonite alternates with delicately streaked pink and grey rock; grey chert with bright pink spots; and marbled pink, white and butterscotch-coloured varieties. The largest unfractured and massive specimens are roughly 1 metre in diameter.

MICROSCOPIC PETROGRAPHY

The predominant minerals of the Snowy Creek manganese silicate/carbonate occurrence are microcrystalline quartz interbedded with disseminated, mottled and banded rhodochrosite and rhodonite, interlayered with hematite or garnet- rich bands. Parallel and crosscutting vein mineralization is also significant. Spessartite is abundant in some specimens. Overall, rhodonite and rhodochrosite account for at least 45 per cent of the mineralization. Rhodonite corresponds to the bright pink observed in hand specimen while rhodochrosite is a lighter flesh-pink colour. Manganese oxide is invariably present lining hairline fractures and as an oxide coating, 1 to 10 millimetres thick, on the weathered surface.

Accessory minerals associated with the microcrystalline quartz-rich layers are penninite, clinochlore and biotite (possibly the manganese variety mangophyll) and traces of pyrite, chalcopyrite and sphalerite. Stilpnomelane, epidote and unidentified clay minerals are more prevalent within the hematite-rich bands. Clinozoisite and the clinoamphibole grunerite were observed in two samples; one as manganese replacement in an altered basalt exhibiting uralitization and the other associated with rhodonite in a quartz-poor section.

The hangingwall and footwall of the deposit consist of a banded metachert of interlayered hematite and microcrystalline quartz. Ghost radiolarians, infilled by microcrystalline quartz, indicate a ferruginous radiolarian chert protolith. Minor constituents of the wallrock include patchy massive carbonate, bedding-parallel thin biotite platelets and interstitial stilpnomelane.

Within the deposit, manganese silicate/carbonate mineralization is represented by a variety of textures. Rhodonite occurs as intergrowths with massive or crystalline rhodochrosite or by itself as euhedral elongate tabular crystals, stellated crystal masses or sheath-like bundles enclosed within and encroaching upon a microcrystalline quartz matrix. It has also been observed with a coarse-grained prismatic habit. This species has unusually low interference colours. The range in the interference colours of rhodonite may reflect differing calcium contents and suggest a possible solid solution with the calcium-rich manganese silicate bustamite. Rhodonite also forms spongy porphyroblasts, 500 microns in length. These are obliquely oriented in a finely laminated garnet-rich metachert. Rhodonite is seen to have grown at the expense of garnet, whereas rhodochrosite and garnet appear to stably coexist. In thin section some rhodonite samples exhibit mammillary growth textures. In other cases, prismatic rhodonite crystal overgrowths enclose interiors of botryoidal and mammillary growth, marked by dark opaque oxide along the curved surfaces. These relationships suggest that mammillary growth preceded crystal growth. Mammilary textures are indicative of open-space filling and mineralization.

Rhodochrosite ranges from massive carbonate either by itself or associated with microcrystalline quartz, rhodonite or disseminated hematite, to crystalline aggregates and intergrowths. The massive rhodochrosite is often bounded by thin layers of stilpnomelane and iron staining. It also occurs as euhedral rhombic crystals, up to 750 microns in size and, in at least one instance, is associated with euhedral zoned quartz crystals, further evidence for open-space growth.

Alumina, derived from feldspar and clay, exerts a compositional control on the distribution of spessartite. This is illustrated by the concentration of fine-grained, euhedral garnet dodecahedrons at and close to the margins of the deposit. The present mineral assemblage of quartz-rhodonite-rhodochrosite-spessartite-grunerite is of metamorphic origin, rather than original. The rhodonite porphyroblasts are evidence for this. The deposit has been metamorphosed under pressure-temperature conditions of prehnite-pumpellyite to greenschist facies as shown by assemblages in metabasalts (Nelson, 1990, this volume). The coexistence of rhodonite, rhodochrosite and quartz implies conditions of XCO_2 and temperature approximately on the reaction rhodochrosite + quartz = pyroxmangite + CO_2 investigated by Candia *et al.* (1975). This implies very low values of XCO_2, for a total pressure of 2 kilobars and a temperature of 375°C. (Nelson, 1990).

Euhedral pyrite rhombs and cubes with pitted interiors and overgrowths of chalcopyrite and sphalerite, exhibiting chalcopyrite exsolution textures, propagate along one of the iron-stained microlaminae which represent original bedding.

A variety of veinlets and gash veinlets crosscut the deposit. Veinlet mineralization includes: microcrystalline and massive quartz, microcrystalline quartz lined with barite, quartz carbonate and penninite intergrowths, massive and crystalline rhodochrosite, adularia and biotite, adularia and stilpnomelane, and stilpnomelane. Veinlet widths range from 10 microns to 250 microns. Network rhodochrosite veining contributes to the overall pink colour of the rock.

DISCUSSION AND CONCLUSIONS

The Snowy Creek rhodonite deposit is a small syngenetic occurrence. Field relationships, macroscopic and microscopic textures and mineralogy point to its origin as an ocean floor hydrothermal system that produced both exhalitive and hydrogenous mineralization at the seawater-sediment interface and apparently epigenetic effects in unconsolidated sediments. The occurrence is stratabound within radiolarian chert, yet replacement textures and open-space filling, which are epigenetic in origin, occur adjacent to delicate manganese silicate/carbonate laminations. Colloform textures may also be suggestive of accretionary growth similiar to that of modern marine manganese nodules. On the other hand, the presence of iron, copper and zinc sulphides, barite and adularia are additional evidence for hydrothermal precipitation and deposition, as opposed to classic manganese crust formation by hydrogenous precipitation and suboxic diagenesis.

Manganese behaviour is controlled by the oxidation state of the depositional environment; manganese is highly soluble under reducing conditions (Maynard, 1983). The preservation of a substantial unit of manganese silicate/carbonate, bounded by massive red cherts at Snowy Creek, suggests that oxidizing conditions prevailed during deposition or concentration of manganese. The precipitation of manganese oxide was probably mediated by the presence of an iron oxide substrate (the ferruginous cherts) which had the ability to adsorb appreciable quantities of ions out of seawater. Iron oxides were deposited under pH conditions of above 3 (Maynard, 1983). Once established, under stable oxidizing conditions and a pH equal to or greater than 8.5, manganese oxide accumulated. Low-temperature diagenesis and low-grade metamorphism subsequently released silca from the radiolarian cherts which combined with the manganese oxide to form rhodonite.

The Snowy Creek deposit represents a small but interesting rhodonite resource. The apparent hardness of the carveable stone ranges from 4 to 6 depending on the relative concentrations of rhodonite, rhodochrosite and quartz. The overall colour and quality is fair to good and is a vibrant mix of light and dark pinks and greens.

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