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Fluorite from Princess Royal Islands: Historic and Possible Economic Significance

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ABSTRACT. Armstrong, physician and naturalist assigned to McClure's *Investigator* (1949-52), reported garnet, a typically metamorphic mineral, in unmetamorphosed rocks of Princess Royal Islands. During recent visits to these islands a few crystals of purple fluorite were found near the northeast tip of the smaller, northernmost island. However, no garnet was found on either island.

Key words: Princess Royal Islands, Blue Fiord Formation, fluorite

RÉSUMÉ. Armstrong, médeçin et naturaliste à bord de l'*Investigator* de McClure de 1949 a 1952, signala la présence de grenat, un minéral typiquement métamorphique, dans les roches non métamorphosées des îles Princesse Royale. Au cours de visites récentes à ces îles, quelques cristaux de fluorine mauves furent trouvés à la pointe nord-est de la petite île la plus au nord. Cependant, aucune trace de grenat ne fut relevée sur ni l'une ni l'autre des îles.

Mots clés: îles Princesse Royale, formation du Fjord Bleu, fluorine

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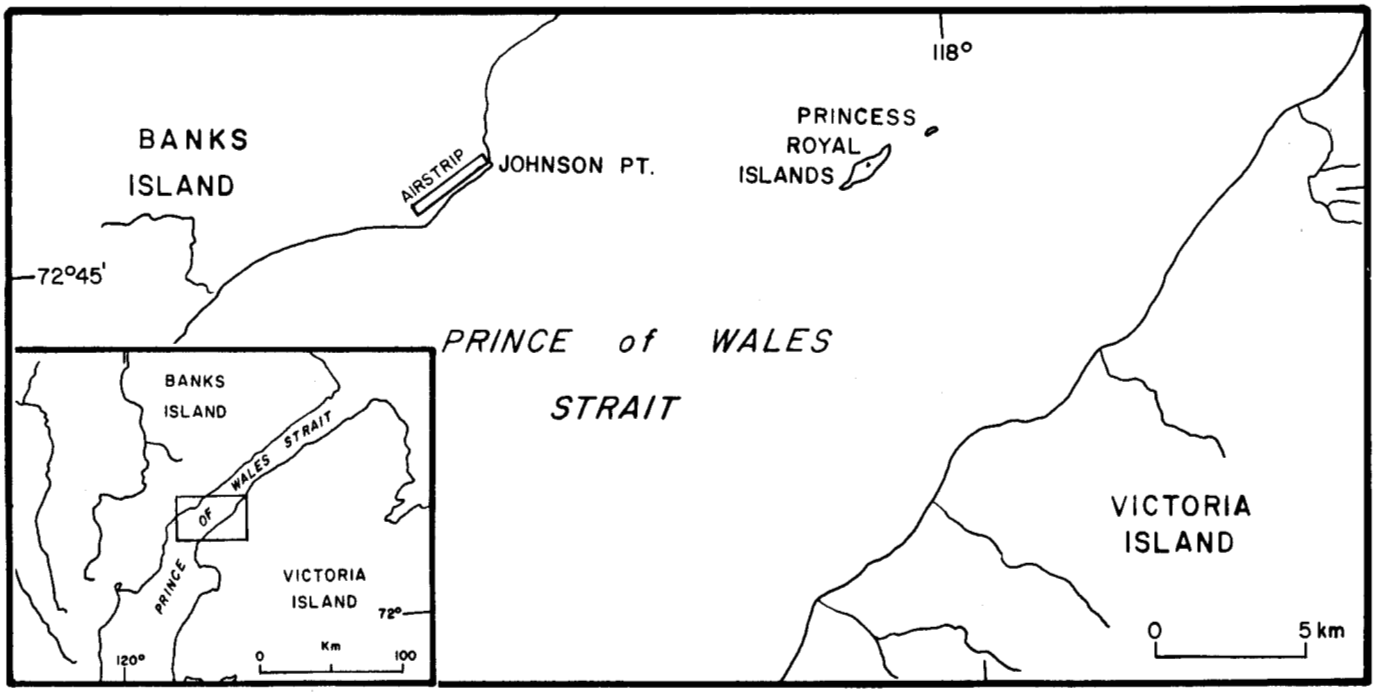

FIG. 1. Location of Princess Royal Islands.

INTRODUCTION

The Princess Royal Islands are near the centre of Prince of Wales Strait, between Banks and Victoria Islands (72°46'N, 118°05'W; Fig. 1). They were discovered in the European sense and named by members of H.M.S. *Investigator,* who had been sent via the Pacific Ocean to search for the lost Franklin expedition. Commander Robert McClure and his men spent the winter of 1850-51 in the vicinity of the islands and established a depot there. Eventually, they made the first successful completion of the Northwest Passage, although they had to abandon the *Investigator* at Mercy Bay, northern Banks Island, and make part of the journey on foot. Armstrong (1857), Osborn (1856), and Neatby (1967) gave accounts of the journey based on the diaries of Armstrong (ship's physician), McClure (captain) and Johann Miertsching (interpreter) respectively.

In the course of regional mineral exploration in the summer of 1978, two of us (DB and WS) visited the smaller of the two Princess Royal Islands and discovered fluorite, a calcium fluoride mineral that commonly occurs as cubic crystals.

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FIG. 2. Smaller of the two Princess Royal Islands. View is to the northeast. (Photo by Charles Jefferson.)

GEOLOGY

The smaller island is approximately 400 × 100 m and trends mainly NE-SW. In the west it is generally flat, rising gently southeastward, and then descending sharply into the ocean at the southeastern edge (Fig. 2). Maximum elevations are in the order of 10-15 m. Bedrock is well exposed because of the lack of vegetation and overburden. Middle to Lower Devonian crinoidal limestone of the Blue Fiord Formation constitutes the entire island (Thorsteinsson and Tozer, 1962; Miall, 1976). A 1-2 m wide fracture zone trends northwesterly across the northeastern end of the island. The zone contains numerous white calcite veins and is believed to reflect a vertical fault (Fig. 3). On the northeast corner of the island, just above the waterline, a smaller subsidiary fracture zone runs parallel to the trend of the island for approximately 5 m. The country rock adjacent to the fractures is characterized by secondary fluorite and white calcite crystals. The maximum width of this zone is 5 cm. Samples from this fracture zone are medium-grained crinoidal limestone containing distinctive dark-purple fluorite cubes as large as 11 mm across but generally 2-3 mm across (Fig. 4). Many of the fluorite crystals have thin (1 mm wide) rims of clear to translucent colourless fluorite. The larger crystals contain patches of colourless fluorite and inclusions of calcite including crinoid columnals (Fig. 4).

The surrounding rock contains a number of tiny centres that fluoresce yellow-orange under ultraviolet light, but the fluorite is non-fluorescent.

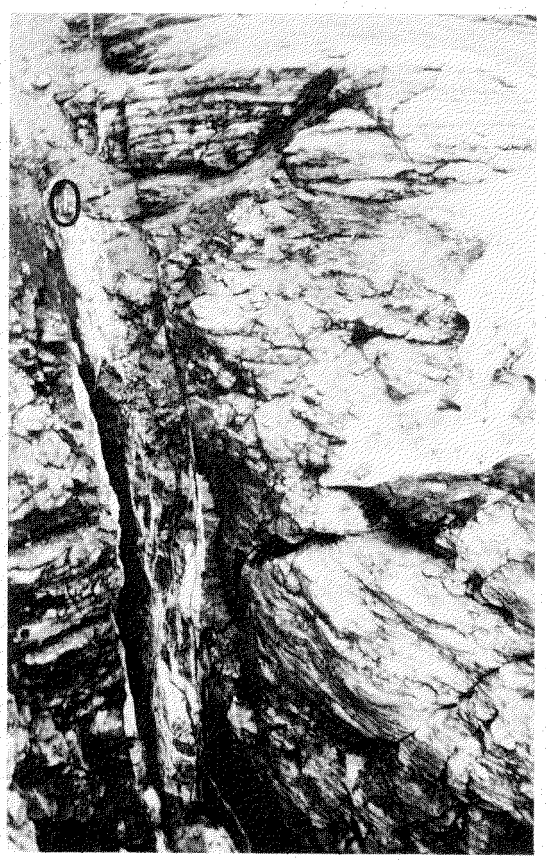

FIG. 3. Fracture-zone near the northeast end of the smaller of the Princess Royal Islands. View is facing northeast. Fluorite was found below and to the right of the field of view. Note geological hammer on fracture-zone in upper left of photo for scale. (Photo by Charles Jefferson.)

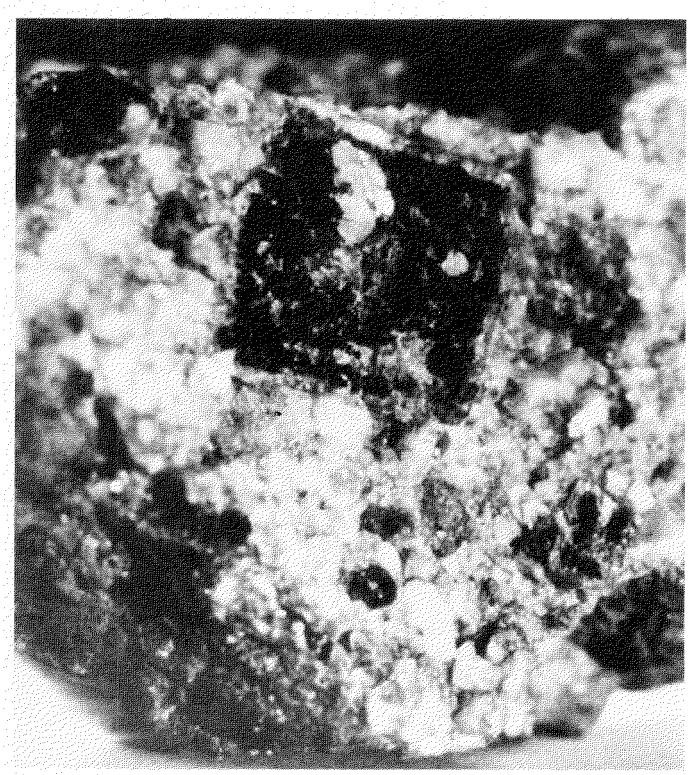

FIG. 4. Purple fluorite (black) from the northeastern corner of the smaller Princess Royal Island. Large crystal is 11 mm across. Note clear fluorite rim and center (grey) and crinoid columnal (white) in upper left of large fluorite crystal.

HISTORICAL SIGNIFICANCE

Armstrong (1857:268), physician on the *Investigator*, described the geology of the small island as "limestone . . . in some situations . . . plentifully studded with garnets." Thorsteinsson and Tozer (1962:53) did not visit this island but questioned the credibility of Armstrong's observation, "because of the unmetamorphosed state of the Devonian rocks of the map area." They suggested that the rocks in question might have been glacial erratics from a distant source (Thorsteinsson, pers. comm., 1983). Sangster (1978:8) commented: "These 'garnets' are almost assuredly red sphalerite, the ore mineral of zinc."

We must conclude that Armstrong misidentified purple fluorite as garnet. If the large crystal shown in Figure 4 is viewed at

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Spiders (Araneae) from the Alpine Zone of the South and West Flanks of Mt. Wrangell, Alaska (62°N, 144°W)

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ABSTRACT. A series of spiders was collected during a summer season from the alpine zone of Mt. Wrangell, Alaska (62°N, 144°W). Most of the species collected have also been taken from lowland sites in the boreal forest and the Arctic and have extensive ranges in the northern nearctic. Some of these species also occur in the palearctic. The dominant families were the Linyphiidae (Erigoninae and Linyphiinae) and the Lycosidae, the only families represented by more than two species within a family. The other families represented were the Agelenidae, Araneidae, Dictynidae, Salticidae and Thomisidae. A phalangid and trombidiiform mite were also collected.

Key words: spiders, Mt. Wrangell, alpine zone, Alaska, nearctic and holarctic distribution

RÉSUMÉ. Une quantité d'araignées furent recueillies pendant l'été dans la zone alpine du mont Wrangell, en Alaska (62°N, 144°O). La plupart des espèces trouvées ont aussi été prises dans des sites montagnards de la forêt boréale et dans l'Arctique et ont une vaste distribution dans le nord des régions néarctiques. Certaines des espèces sont aussi trouvées dans le paléarctique. Les familles dominantes furent les Linyphiidés (les Ergonidés et les Linyphiinés) et les Lycosidés. Elles furent les seules familles représentées par plus de deux espèces au sein d'une même famille. Les autres familles représentées furent les Agélénidés, les Aranéïdes, les Dictynidés, les Salticidés et les Thomisidés. Une mite phalangide et trombodiiforme fut aussi recueillie.

Mots clés: araignées, mont Wrangell, zone alpine, Alaska, région néarctique, distribution holarctique

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In view of the enormous ecological and biogeographical importance of the region, it seems unfortunate that we know practically nothing of the high altitude insects of the Alaskan mountains. [Mani, 1968:393.]

INTRODUCTION

While the above quote by Mani refers to insects, it is clear from the thrust of his book that he included all terrestrial arthropods within his scope, and the quote is certainly applicable to the arachnids as well. In 1978 one of us (RS) made a solo expedition to study the biology and geology of the southern and western flanks of Mt. Wrangell, southeastern Alaska, approximately 62°N, 144°W. Collections were made between 6 June and 22 July in the alpine zone. In 1980 an additional specimen was procured on a shorter trip to the region. A privately printed brochure (Saltmarch, 1978) provides details of the descriptive biology and geology and of the expedition. The Appendix lists the collecting sites by locality with habitat information. This detailed appendix is necessary for archival reasons, as it is unlikely that arachnids will be collected at any time in the near future in the area. The alpine zone as used in this paper refers to regions above the local treeline. Camps were pitched beside flowing water, thus accounting for bias toward stream or riverside collecting sites.

METHODS

Spiders were collected by handpicking or by sweeping vegetation. No attempt was made to be quantitative, the goal being to record the species present at the different sites and in different

TABLE 1. Alpine spiders from Mt. Wrangell

Taxon	Collection Number
Agelenidae	
Cicurina species, immature male	S837
Araneidae	
Aculepeira carbonarioides (Keyserling)	S839, 52, 54
Hypsosinga groenlandica Simon	S826
Dictynidae	
Dictyna major Menge	S835
Linyphiidae	
Erigoninae	
Baryphyma species male	S830
Ceraticelus crassiceps (O. P. Cambridge)	S837
Erigone species female	S4
Walckenaeria species male	S830
Undetermined female, eight immatures	S837, 40, 57
Linyphiinae	
Lepthyphantes alpinus (Emerton)	S837
L. washingtoni Zorsch	S826, 30, 35
Pityohyphantes species female	S837
Lycosidae	
Alopecosa aculeata (Clerck)	S826, 30
Pardosa albomaculata Emerton	S831
P. furcifera (Thorell)	S826
P. groenlandica (Thorell)	S833, 50
P. hyperborea (Thorell)	S826, 34
P. palustris (Linnaeus)	S830
P. uintana Gertsch	S834
Salticidae	
Chalcoscirtus carbonarius Emerton	S856
Thomisidae	
Xysticus deichmanni Sörensen	S831

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an angle to its crystallographic axis, a rounded five-sided outline reminiscent of cross sections of garnet dodecahedrons or trapezohedrons appears. Nevertheless, fluorite from the northern Princess Royal Island can be readily distinguished from garnet by its cleavage, hardness, deep-purple colour, fusibility, cubic crystal form, and the unmetamorphosed nature of the host rock. It is distinguishable from sphalerite by crystal form, colour, streak, luster, fusibility, and density.

ECONOMIC SIGNIFICANCE

In many carbonate-hosted lead-zinc mining districts, fluorite and barite are commonly associated with sphalerite (zinc sulfide) and galena (lead sulfide), forming what are known as Mississippi Valley-type (MVT) deposits. Many of these deposits are associated with carbonate-shale facies transitions (Sangster, 1978; Kerr, 1977). Miall (1976) has demonstrated that the Blue Fiord Formation of Banks Island undergoes a facies change to the west and north with calcareous shales of the Orksut Formation. The Blue Fiord Formation also contains fluorite-bearing veins and bitumen in an oil well at Stokerson Bay on the west coast of Banks Island, 200 km west of Princess Royal Islands (Miall, 1976:69). Galena occurs in the same formation near Weatherall Bay, Melville Island, 500 km to the northeast (Thorsteinsson and Tozer, 1964:225). Because important MVT lead-zinc deposits at Little Cornwallis Island (Kerr, 1977) and Nanisivik, Northern Baffin Island, account for the only mineral production and proven ore reserves in the Canadian Arctic Archipelago, it seems reasonable to search for undiscovered MVT deposits in areas of favourable geology. Some of these areas were discussed briefly by Gibbins (1983).

On the negative side, one of the most important deterrents to mineral exploration in areas of Blue Fiord Formation is the lack of detailed geological maps and information, and even the information available is not very encouraging. The two fluorite and single galena occurrences are widespread, making an extremely large target area. They are present in calcite veins in limestone rather than in the porous and brecciated dolomitic host-rocks of most MVT deposits.

Fluorite is a relatively common mineral that occurs in many geological environments, but it is relatively uncommon in MVT districts of northern Canada (Gibbins, 1983:404). Common characteristics of MVT districts are absent (dolomitization, major tectonic structures and related unconformities) or limited (karsting and solution collapse). However, bitumen and an intra-formational unconformity are present locally (Charles Jefferson, pers. comm., 1984). The Stokerson Bay occurrence is 2 km below the surface, the Princess Royal Island occurrence is on a tiny island, and the Weatherall Bay locality has almost no shipping season. There do not appear to be any suitable geological criteria for selecting favourable areas of Blue Fiord Formation, nor are there sufficiently cost-effective and efficient geophysical or geochemical exploration techniques to make this particular formation or area an attractive target for mineral exploration.

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