

A treasure trove of minerals disco

The Larsemann Hills was first sighted by Norwegians in 1935, but it was not until the late 1980s that detailed geological investigations commenced.

These early investigations reported large, abundant prisms of a near-black mineral, which the geologists described as 'tourmaline'. Several years later, Chinese and Australian geologists showed that the prisms, as large as piano keys, were actually 'prismatine' – a much rarer mineral containing boron and silicon (Figure 1) – and another rare borosilicate, 'grandierite'. The rocks making up a prominent peak on central Stornes contain prismatine in such abundance that it has been named Prismatine Peak (originally called Tourmaline Peak).

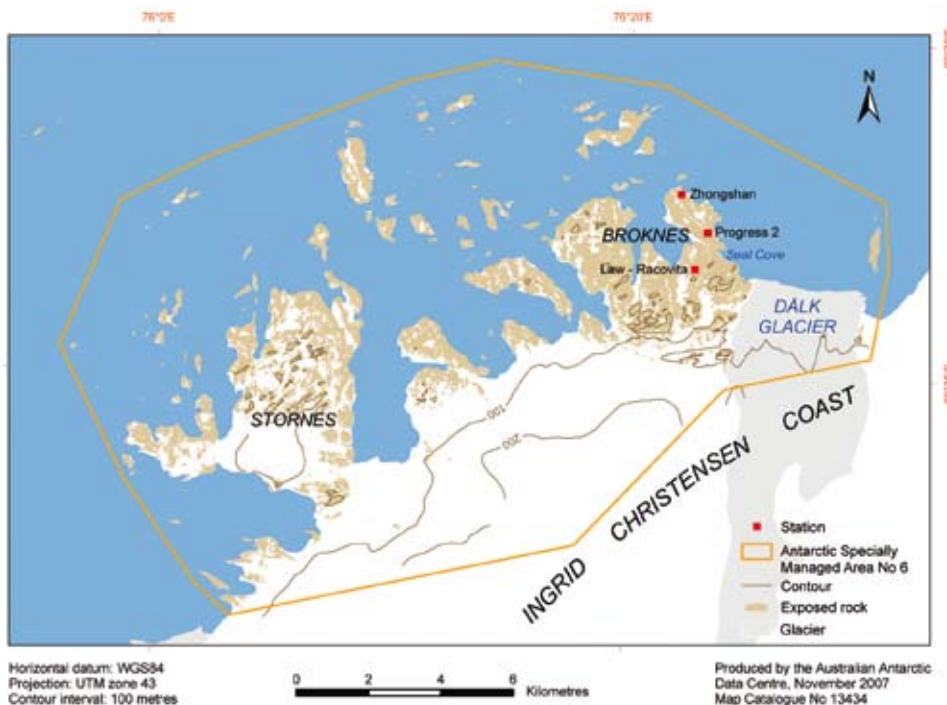
In 2003-04, we found the mineral bands to be associated with nodules of the common calcium phosphate mineral, 'apatite'. Both the boron-rich rocks and the apatite contained a variety of minerals, four of which are new to science.

Boron-rich rocks

The Larsemann Hills contains sedimentary and volcanic rocks that were laid down between 900 and 550 million years ago. Some of these rocks were unusually rich in boron. The rocks were subsequently buried, 'metamorphosed' (changed from one type of rock into another) at temperatures of 800-860°C, and squeezed by tectonic forces during the collision of East Gondwana and West Gondwana some 515-530 million years ago. The resultant amalgamation formed the super-continent Gondwana. Under these conditions the metamorphic rocks melted, resulting in two other rock types, 'granite' and 'pegmatite', both of which are common in the Larsemann Hills.



Figure 1. Prismatine (dark crystals) in cordierite (bluish matrix) near Prismatine Peak, Stornes.



The Larsemann Hills, on the eastern shore of Prydz Bay, was first sighted by a Norwegian whaling expedition in 1935. Many prominent geographic features were named by the Norwegians, including Broknnes and Stornes ('nes' meaning peninsula). Several reconnaissance geological studies were conducted in the region during the 1950s and 60s, and detailed geological investigations commenced in the late 1980s, with three nations establishing research bases on Broknnes – namely Progress 1 and 2 (USSR/Russia), Zhongshan (China) and Law (Australia).

Six borosilicate minerals have been found so far in the Larsemann Hills – prismatine, grandierite, boralsilite, werdingite, dumortierite and tourmaline. The most unusual of these is boralsilite, which was discovered in the Larsemann Hills in 1998 and named for its composition, boron, aluminium and silicon.

We found boralsilite at nine localities on Stornes during the 2003-04 field season. The colourless prismatic mineral can be seen with the naked eye and recognised in the field, and is distinguished under the microscope by its striped appearance (Figure 2). Outside the Larsemann Hills, boralsilite is known only from Rogaland, Norway.

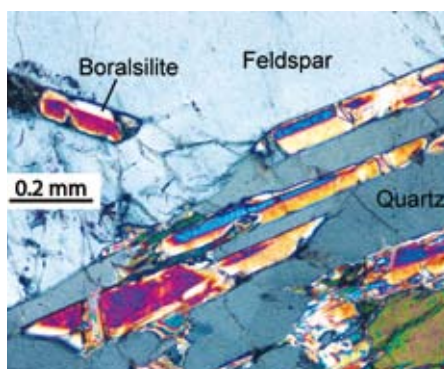


Figure 2. Photomicrograph of striped boralsilite prisms from southern Stornes, (taken with crossed polars).

The distinctive borosilicate mineral assemblage in the Larsemann Hills is attributed to a variety of factors, including the high boron content of the source rocks and their relatively low water content, which caused an unusual enrichment of boron, but not of other elements normally concentrated in pegmatites, such as lithium and beryllium.

Apatite-associated minerals

Large brown nodules of apatite – which can be up to 10 cm across – are associated with boron-rich rocks and other rock types (Figure 3). Eight phosphate minerals have been found in apatite nodules, three of which are new and, to date, have only been found in the Larsemann Hills. The three new phosphate minerals – stornesite-(Y), chopinite and tassieite – are microscopic and very rare.

Stornesite-(Y) is a sodium-calcium-magnesium-rich phosphate, named for Stornes and for the element yttrium-(Y). Its closest relative is the yttrium-free phosphate 'chladniite' reported in two meteorites.

Chopinite is dominantly magnesium phosphate with iron. It was named in honour of French mineralogist, Christian Chopin. Four sub-millimetre-sized grains were found in a single thin section of apatite.

Tassieite (Figure 3 insert) is a sodium-calcium-iron-magnesium phosphate, containing water lodged in its structure. It was named for Tassie

Discovered in the Larsemann Hills

Tarn south of Johnston Fjord, which has an outline resembling that of Tasmania.

The Larsemann Hills is unique in its mineral diversity. Four new mineral species have been found, while three other minerals are known from only a handful of other locations worldwide. Several rare species are also found in unusual abundance in the Larsemann Hills. This unique mineralogy, as well as the region's other scientific, environmental, aesthetic and logistical values, has led to its recent designation as an Antarctic Specially Managed Area (see story below).

PROFESSOR EDWARD GREW
Department of Earth Sciences, University of Maine, USA

DR CHRIS CARSON
Geoscience Australia



Figure 3. Photograph of the apatite nodule (next to pen) from which the crystals of stornesite-(Y) and tassieite were extracted to determine the physical and chemical properties of the two minerals. Inset is a photomicrograph of 'type' tassieite crystals in apatite in plane-polarised light. These crystals were used to characterise tassieite as a new species. From southwest of Johnston Fjord and near Tassie Tarn, Stornes.

ANTARCTIC OASIS DESIGNATED AN 'ANTARCTIC SPECIALLY MANAGED AREA'

Antarctic coastal ice-free areas – such as the Larsemann Hills – are rare, making up less than 0.5% of the continent. The relatively favourable habitat and climate, proximity to the ocean, and availability of fresh water, mean that such 'oases' are hotspots of Antarctic biodiversity, and in demand for the conduct and support of human activities. These features create a potential for human activities to impact on the environmental qualities that make coastal ice-free areas special in their own right and valuable research sites.

Australia, China and the Russian Federation set up facilities in the Larsemann Hills in the late 1980s. Romania entered the scene a couple of years ago through an arrangement to use Australia's existing facilities, and India has recently installed some



Following its designation as Antarctic Specially Managed Area No.6, international activities in the Larsemann Hills will be formally managed to safeguard the environmental and scientific values of this coastal 'oasis'.

temporary huts at the location of a planned new station. Now these, and other countries, have agreed on ways to minimise the impacts from their individual and collective activities in this 40 km² region of ice-free ground and unspoiled lakes.

Over several years, Australia led work with these partner countries to prepare the required management plan to make the Larsemann Hills an Antarctic Specially Managed Area (ASMA). The ASMA designation aims to protect the Larsemann Hills environment by establishing a formal framework for close collaboration and cooperation in science, operations and environmental protection. The management plan was considered and endorsed by the 10th meeting of the Antarctic Treaty's Committee for Environmental Protection (CEP) in May 2007, in conjunction with the 30th Antarctic Treaty Consultative Meeting (page 20).

The focus has now shifted to working closely with the other countries active in the region to implement the management plan. Australian Antarctic Division representatives held productive discussions during a meeting of the Larsemann Hills ASMA Management Group in July. Priorities for future action include the collective development of comprehensive quarantine procedures, cooperation on logistics and facilities, collaborative research and monitoring, and effective exchange of information.

EVAN MCVIVOR
Antarctic Territories, Environment and Policy, AAD

CEP update

As well as endorsing the management plan for the Larsemann Hills, the 10th CEP meeting continued discussion of the future challenges facing Antarctica (see *Australian Antarctic Magazine* 11: 31), and endorsed a provisional five-year work plan. The plan places a high priority on actions to address the introduction of non-native species to Antarctica, possible impacts of non-governmental activities, the effects in Antarctica of global pressures, such as climate change and pollution, and development of an Antarctic marine protected areas system. Australia helped champion this new strategic approach to the Committee's work, and will remain closely involved in the efforts required to take the good ideas and goodwill from the meeting room to the ice.