

## Planning and Scientific Program of the GEISHA Expedition

By Norbert W. Roland\*

**Summary:** The first German geological expedition to the Shackleton Range (GEISHA) in 1987/88 had a planning and preparatory phase of four years, during which the logistics concept for the expedition had to be changed twice. The expedition was logistically complicated and required the support of an icebreaker (RV *Polarstern*), two fixed-wing aircraft (*Polar 2* and *Polar 4*), and two helicopters, as well as the standard field equipment, including motor toboggans and sledges.

The scientific program brought together earth scientists who had worked before in various other structural units of the Antarctic. It was based on the knowledge of the previous British and Soviet expeditions and tried to solve some of the remaining problems, especially with respect to the stratigraphy, but also included structural, geological, and plate tectonic aspects.

**Zusammenfassung:** Die erste deutsche „Geologische Expedition in die Shackleton Range“ (GEISHA, 1987/88) hatte eine Planungs- und Vorbereitungsphase von vier Jahren. Während dieser Zeit mußte das logistische Konzept zweimal aus verschiedenen Ursachen geändert werden. Die Expedition war logistisch kompliziert und erforderte den Einsatz eines Eisbrechers (FS *Polarstern*), zwei Polarflugzeugen (*Polar 2* und *Polar 4*), zwei Hubschraubern und der Standard-Geländeausrüstung, einschließlich Motorschlitten und Nansen-schlitten.

Das wissenschaftliche Programm führte Geowissenschaftler zusammen, die bisher in unterschiedlichen Struktureinheiten der Antarktis gearbeitet hatten. Es basierte auf den Ergebnissen der bisher durchgeführten britischen und sowjetischen Expeditionen und versuchte noch verbliebene Probleme speziell auf stratigraphischem Sektor zu lösen, schloß aber auch strukturgeologische und plattentektonische Aspekte mit ein.

### PLANNING AND PREPARATORY PHASE

The desire to organize a geological expedition to the eastern shore of the Weddell Sea was expressed for the first time on the occasion of a round-table talk on geoscientific research in Antarctica of the German Society for the Advancement of Science (DFG) in March 1980. The idea of a geoscientific expedition to the region of the Pensacola Mountains and the Shackleton Range was put into more concrete terms during the meeting of German geologists specialized in the Antarctic in Darmstadt in June 1983 (DEUTSCHE GESELLSCHAFT FÜR POLARFORSCHUNG 1984). During the 4th meeting of the Working Group on the Geology of Polar Regions of the German Society of Polar Research (DGP) in Hannover on 25 and 26 April 1985, the status and chances of a Shackleton/Pensacola project were discussed again; it was resolved to begin detailed planning of a Shackleton Range expedition and a research program was set up which included the objectives of the working groups from the universities of Aachen, Göttingen, Erlangen, Darmstadt, Münster, and the BGR Hannover.

Initially, two target areas were under discussion: the Shackleton Range and the Pensacola Mountains, both of them being of great geoscientific interest. The decision was made in favour of the Shackleton Range, mainly because of the fact that this area is more easily accessible. Nevertheless, problems were yet to occur during the later phases of planning. The original logistic concept envisaged a sledge traverse from the Soviet summer base of Drushnaya I to the Shackleton Range. A reconnaissance survey using polar aircrafts during the 1985/86 season revealed that the Shackleton Range is not accessible by a land traverse across the Grand Chasm crevasse area on the Filchner Ice Shelf.

Consequently, the expedition team was reduced to 12 participants, skidoos and helicopters were envisaged for transport in the field, and it was planned to transport supplies to the Shackleton Range group with one of the ski planes (*Polar 4*), whereas *Polar 2* was planned to be used for aeromagnetic survey flights.

During another meeting in Würzburg on 3 October, 1986, however, the logistics concept had to be changed again. After three huge ice islands had broken off the Grand Chasm on the Filchner Ice Shelf, the Soviet Drushnaya I summer station, now located on one of the ice islands, was no longer available. For safety reasons, it did not seem advisable to let the RV *Polarstern* operate between the ice floes and the ice shelf to transport the expedition team and equipment to the new edge of the shelf ice.

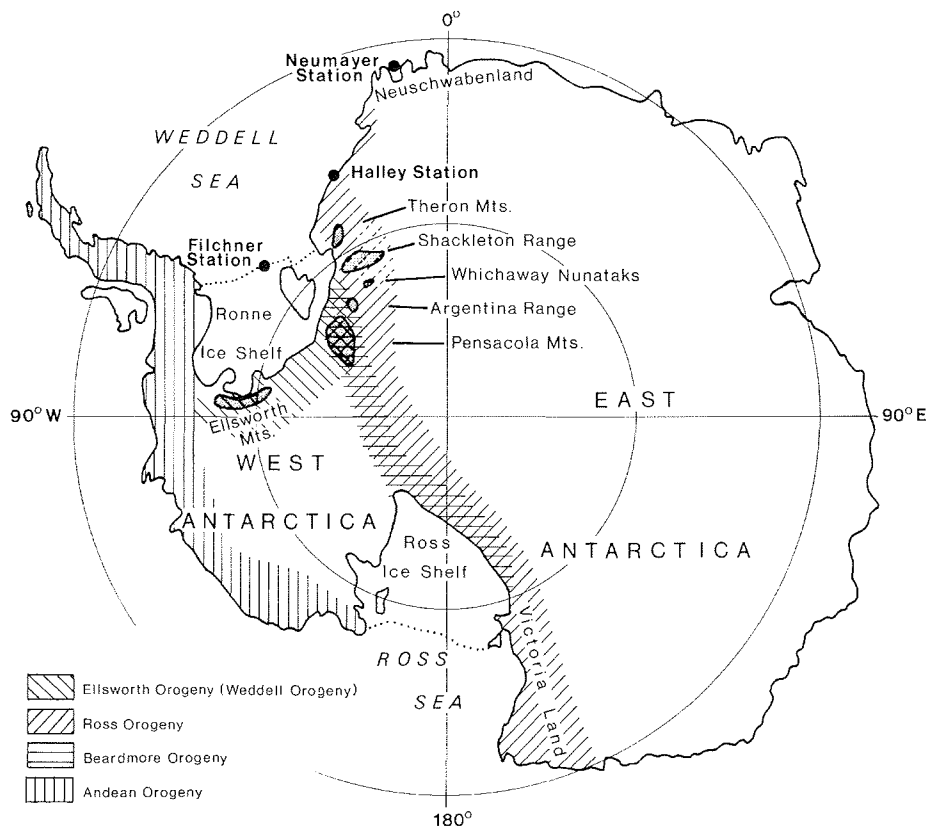
After the 7th meeting in the Institute of Applied Geodesy (IfAG) in Frankfurt in 1987, it was clear that the British Halley Station was the only suitable starting point for the expedition. The aerogeophysical program was cancelled, since the transport of supplies over almost 600 km required both polar planes.

Between 19 December 1987 and 19 March 1988, the Geological Expedition to the Shackleton Range, GEISHA, was jointly implemented by the Alfred Wegener Institute for Polar and Marine Research (AWI), Bremerhaven, and the Federal Institute for Geosciences and Natural Resources (BGR), Hannover. The expedition was carried as part of the *Polarstern* expedition ANT-VI/3 of AWI.

### *Aims of the project*

It was planned that the Geological Expedition to the Shackleton Range (GEISHA) would benefit from the experience of the German geoscientists who had worked in northern Victoria

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**Fig. 1:** Structural sketch map of Antarctica. The Shackleton Range is considered to be a key area for the understanding of geotectonic processes at the paleo-Atlantic/Pacific rim of Gondwana.

**Abb. 1:** Strukturelle Übersicht der Antarktis. Die Shackleton Range gilt als Schlüsselgebiet zum Verständnis geotektonischer Prozessen am Gondwana-Rand von Paläoatlantik und Paläopazifik.

Land, Neuschwabenland and in the Ellsworth Mountains, i.e. experience gathered in the various major structural units of Antarctica. The Shackleton Range was considered to be the ideal area from which to start a number of studies, since according to the findings on the structure of the eastern flank of the Weddell Sea, the orogenic belts of the Ellsworth Orogen (= Weddell Orogen), the Ross Orogen and the Beardmore Orogen are assumed to intersect in this area (Fig. 1). Additionally, it is assumed that the Shackleton Range is situated in the boundary area between the East Antarctic Shield and the younger orogenic belts, which could mean that it has a structural position similar to that of northern Victoria Land.

Therefore, the position of the Shackleton Range makes a close study of this area essential when the following topics are considered:

- the accretion mechanism at the margins of the East Antarctic Shield,
- the continuation of the Ross Orogen along strike and evidence for the Ross orogeny,
- location of the boundary between the East Antarctic Shield and the west Antarctic mobile zone,
- reconstruction of the Gondwana continent, and the
- break-up history of the Gondwana continent.

#### Scientific Programs

The relationships between the various geological units in the Shackleton Range were not fully understood and have been dis-

cussed in terms of unconformities, normal faults, thrusts, and nappe structures. Stratigraphic uncertainties have resulted from the difficulties in correlating deformational and metamorphic events. Polymetamorphism and repeated deformation are probably the main causes of the remaining questions about the interpretation of the available radiometric dates, which has hindered the working out of the tectonometamorphic history of the Shackleton Range.

On the basis of knowledge gained on the previous British and Soviet expeditions (the latter in cooperation with colleagues from the former GDR) between 1957 and 1978, the following programs were planned for the GEISHA expedition (ROLAND et al. 1988):

- Stratigraphic correlation of the rocks of the Turnpike Bluff and Blaiklock Glacier groups combined with investigations of the sedimentary facies.
- Study of the crystalline basement rocks, with the main emphasis on the petrology of the metamorphic rocks.
- Structural investigation of the crystalline basement rocks and the sedimentary units, particularly in the Read Mountains and the Otter and Haskard Highlands, special consideration being given to shear and movement zones.
- Recording of all basic dykes according to their attitude, associated rocks, relative age, absolute age, geochemistry, and paleomagnetism, particularly in the Read Mountains and Haskard Highlands.
- Study of the glacial geology, recording and mapping the rock types of the erratics and recording all glacial phenomena.

Additionally, it was planned to compare the geological and tectonic evolution of the Shackleton Range with the geology of areas previously investigated by the expedition participants (Victoria Land, Neuschwabenland, and Ellsworth Mountains).

Staff members of the geological and mineralogical institutes of the universities of Aachen, Erlangen, Göttingen, Frankfurt, and Würzburg, as well as the BGR, participated in the scientific studies. The studies provided new information on the structure and geotectonic position of the Shackleton Range. The results are summarized in this volume. They gave the impetus to plan another expedition to these mountains on a European level. All countries which have already done research work in the Shackleton Range - the Federal Republic of Germany, the former GDR, the UK, and the former USSR - are to participate in the expedition. This was agreed upon during an international Shackleton Range Workshop in Hannover in April 1990 (TESSENHORN & THOMSON 1990). The European expedition to the Shackleton Range (EUROSHACK) will presumably be carried out during austral summer 1994/95.

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