Polarforschung 63 (1): 5–8, 1993 (erschienen 1994)

Logistics of the GEISHA Expedition

By Jürgen Kothe*, Norbert W. Roland*, and Karl-Heinz Bässler**

Summary: The geological expedition to the Shackleton Range (GEISHA 1987/88) was not only the southernmost German Antarctic expedition, but also a logistically complex operation. Additionally, the initial logistic concept had to be modified during the planning and preparation phases. Instead of transport to the Shackleton Range by land two ski-equipped aircraft were necessary. Additionally, the RV *Polarstern* had to be used to reach the Brunt Ice Shelf near the British Halley Station, from where the geological expedition to the Shackleton Range was to start.

To make optimum use of the short time available, the field work was supported by two helicopters in addition to motor toboggans (skidoos) and sledges, which were available at each camp, making it possible to continue the scientific programs even on white-out days. This worked out very well and more field work could be done than originally planned.

Zusammenfassung: Die „Geologische Expedition in die Shackleton Range" (GEISHA, 1987/88) war nicht nur die südlichste deutsche Antarktisexpedition, sie war auch logistisch aufwendig. Zudem mußte das logistische Konzept in der Planungs- und Vorbereitungsphase durch verschiedene Umstände geändert werden. Anstelle einer ursprünglich geplanten Traverse mit schweren Schlittenzügen, während der die Ausrüstung in die Shackleton Range gebracht werden sollte, wurde die logistische Unterstützung durch Flächenflugzeuge unabdingbare Voraussetzung. Hinzu kam, daß Expeditionsmannschaft und -ausrüstung mit FS *Polarstern* zum Brunt Ice Shelf, nahe der britischen Halley Station transportiert werden mußten, von wo die Expedition beginnen sollte.

Eine optimale Nutzung der kurzen Geländesaison machte die alternative Nutzung von zwei Hubschrauber und mehrerer Motorschlitten und Nansenschlitten erforderlich. Dies ermöglichte, daß auch an Tagen, an denen die Hubschrauber infolge „white-out" am Boden bleiben mußten, die Geländearbeiten fortgesetzt werden konnten. Dieses Konzept hat sich bewährt und mehr als die ursprünglich geplanten Programme konnten abgeschlossen werden.

INTRODUCTION

The Shackleton Range, located on the southeast margin of the Filchner Ice Shelf and extending as far south as 80° 47' S, was discovered in 1956. During a previous expedition, the range was reached by land. This was originally planned for the „Geologische Expedition in die Shackleton Range" (GEISHA), but could not be realized after three huge ice floes broke from the Filchner Ice Shelf. Instead, two polar aircrafts were needed for the expedition.

The Shackleton Range is nearer the South Pole than all previous German expedition targets in Antarctica. But GEISHA was not only the southernmost German expedition, but logistically the most complex. The following equipment was necessary for the expedition (ROLAND et al. 1988, BÄSSLER & KOTHE 1988):

- the icebreaker RV *Polarstern*,
- two ski-equipped aircraft: *Polar 2* and *Polar 4* (Dornier 228-100),
- two helicopters: (Bölkow 105), including ground power unit and preheating device,
- seven motor sledges (Skidoo Alpine and Skidoo Elan) and seven Nansen sledges,
- three Kässbohrer snow-tracs equipped with snow plow, crane, and container,
- various 20-foot containers as living-quarters, workshop, and store, as well as
- the usual camp equipment, including Scott tents.

The RV *Polarstern* transported the participants of the expedition and equipment to and from Antarctica. The expedition's fuel supply had to be filled into drums (about 900) from tanks on the *Polarstern*. The fuel was stored at a base camp near the ice edge not far from the British Halley Station (GEISHA base camp). A landing strip was prepared, and the polar aircraft were stationed at the GEISHA base camp during the expedition. Another base camp in the Shackleton Range (Shackleton base camp), nearly 600 km further inland, was supplied from the base on the coast by the two aircraft (Fig. 1). During the GEISHA expedition, the *Polarstern* operated in the southeastern Weddell Sea to be ready to provide help if necessary.

The primary task of the aircraft *Polar 2* and *Polar 4* was to transport the expedition members and equipment, as well as to supply the Shackleton base camp with fuel and food. Additionally, the aircraft transported the rock samples and camp wastes back to the coastal base. The two helicopters were used to supply the field camps as well as for geological field work. The skidoos and Nansen sledges proved to be ideal for moving camp and for the field work.

Snow-tracs and freight sledges were employed to transport fuel and the 20-foot containers used for living-quarters and storage purposes at the GEISHA base camp at the coast.

The expedition team of 27 members landed at Mobster Creek, a natural harbour at the edge of the Brunt Ice Shelf near the Halley Station. The equipment of the GEISHA expedition was unloaded using the crane of the British ship RRS *Bransfield*, because the RV *Polarstern* was not able to get close enough to the ice shelf in the narrow Mobster Creek inlet.

The plan to work in the Shackleton Range with both motor toboggans and helicopters proved to be a success. It was possible

* Jürgen Kothe, Dr. Norbert W. Roland, Bundesanstalt für Geowissenschaften und Rohstoffe, Stilleweg 2, D-30655 Hannover.
** Karl-Heinz Bässler, Schlangenwallstraße 36, D-45899 Gelsenkirchen.

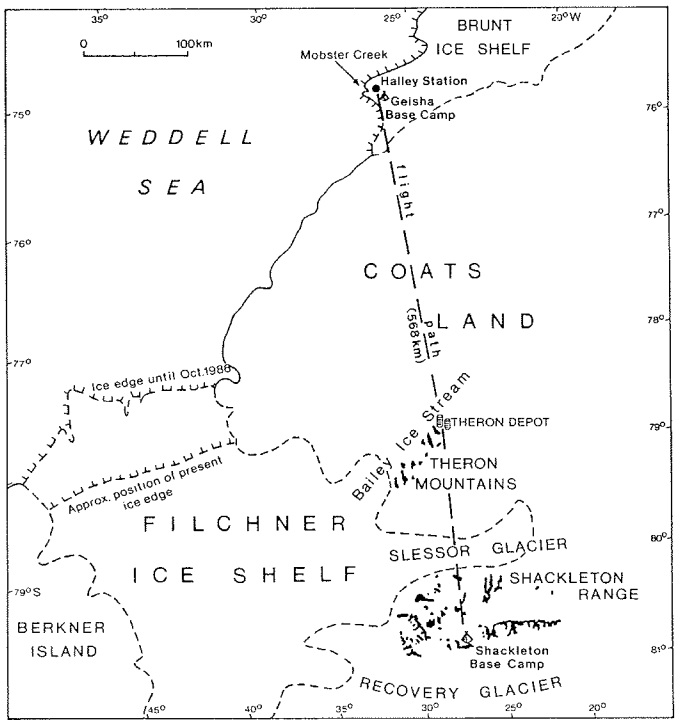

Fig. 1: The southeastern margin of the Weddell Sea from Halley Station to the Shackleton Range.

Abb. 1: Die Lage von Halley Station und der Shackleton Range am Südostrand des Weddell-Meeres.

to carry out geological field work even on those days the helicopters were grounded due to white-out conditions. Thus, the objective to make optimum use of the relatively short period available for field work, five to six weeks at a maximum, was well achieved; the geologists finished the priority work sooner than planned.

In general, the weather conditions were very favourable during the whole time spent in the mountains. White-out conditions prevented flying on only five out of 41 days in the field. In contrast, a thick cloud cover was persistant at the GEISHA base camp on the coast and white-outs occurred more often than in the mountains. The temperature dropped as low as -32.3 °C, but only on a few days just before the end of the working period and only at the Shackleton Range base camp, which was about 1400 m above m.s.l.

Before moving camp with skidoos and sledges, the route was inspected using aerial photographs and/or helicopter to avoid crevasse fields and reduce the risk of traverses across the snow.

SCHEDULE

GEISHA was integrated into the RV *Polarstern*'s schedule for Leg ANT VI-3. On the journeys to and from Halley Station, during which supplies were unloaded at the Neumayer Station and work on the marine geological and biological programs continued, the GEISHA participants had enough time to prepare for their field work, or on the return journey to write up their field observations (FÜTTERER 1988). As can be seen from the schedule (Tab. 1), only 41 days of the 92 days of the expedition could be spent on the field work.

While the participants of the GEISHA expedition were travelling to Antarctica on the RV *Polarstern*, the polar aircraft were already on their way, according to the flight schedule in Tab. 2.

19 December 1987	Departure from Hannover;
20 December	Arrival at Ushuaia, Argentina, embark on the RV *Polarstern*
21-31 December	Survey cruise with the RV *Polarstern*
31 December	Arrival at Neumayer Station at Atka Bay
5 January 1988	Arrival at Halley Station, unload of equipment, set up of GEISHA base camp
8 January	Flight to Shackleton Range, set up of Shackleton Range base camp
8-11 January	Scientists fly to Shackleton Range base camp, beginning of field work
11 Jan.-16 Febr.	Field work in Shackleton Range
17 February	All are back on board the RV *Polarstern*
20 February	Loading of expedition equipment
23 February	Unload equipment at Neumayer Station
24 Febr. - 2 March	Survey cruise with RV *Polarstern;*
3-5 March	Reloading of expedition equipment at Neumayer Station
5 March	Leave Neumayer Station
6-15 March	Survey cruise with the RV *Polarstern;*
18 March	Arrival at Capetown, South Africa.

Tab. 1: Schedule of GEISHA expedition.

Tab. 1: Zeitlicher Ablauf der GEISHA-Expedition.

1-9 Dec. 1987	Flight Hannover-Cologne-Valencia- Las Palmas-Sal-Recife-Rio de Janeiro-Buenos Aires-Punta Arenas
10-21 December	Ski landing gear mounted in Punta Arenas
23 December	Punta Arenas-Rothera-Teniente Marsh, Break off of flight due to deterioration of weather; back to Puerto Williams
26 December	Puerto Williams-Rothera
27 December	Fuel depot established at Fossil Bluff
28 December	Flight Rothera - Fossil Bluff - Halley
29 December	Flight Halley-Neumayer Station
4 January 1988	Neumayer Station-Halley, set up of depot in the Theron Mountains
4 Jan. - 17 Febr.	Flights for GEISHA expedition
19 Febr. - 15 March	Return flight: Halley-Rothera-Teniente Marsh-Puerto Williams-Punta Arenas-Hannover.

Tab. 2: Flight schedule of aircraft *Polar 2* and *Polar 4.*

Tab. 2: Flugplan der Polarflugzeuge *Polar 2* und *Polar 3.*

Polar aircraft and helicopters

The geologists working in the Shackleton Range had to be supplied with food, equipment, and fuel over a distance of nearly 600 km. The pilots flew a total of 53 transport flights: 33 flights with fuel and 20 flights with personnel and equipment. Including the ferry flights of the aircraft from Germany to Antarctica and back, 491 flying hours and a total distance of 120,750 km were flown; of this, 270 flying hours or 83,750 km were flown while supplying the Shackleton Range expedition.

On a single flight to the Shackleton Range, a Dornier 228-100 aircraft transported three barrels of fuel and consumed eight barrels of kerosine in the process. Therefore, optimum planning and coordination of the flights was absolutely necessary to avoid the risk of having to break off a flight and to prevent the consequent waste of fuel. The ninety barrels of Jet-A1 fuel which were delivered to the Shackleton Range were sufficient for 98 helicopter flying hours.

For safety reasons, the ferry flights of the helicopters to and from the Shackleton Range were accompanied by the *Polar 2*. The two helicopters stopped to refuel in the Theron Mountains. Their flight schedule was as below.

11 January 1988	Flight GEISHA from base camp via Theron Mountains depot to the Shackleton base camp.
12 January - 14 February	General flights to supply and support field parties.
14 February	Return flight back to GEISHA base camp at Halley via the Theron Mountains depot.

Camps and Depots

Two base camps were established to guarantee optimum logistical support for the field work:
The GEISHA base camp on the coast at position 75° 37' S, 26° 44' W near the British Halley Station and Mobster Creek, an inlet at the edge of the Brunt Ice Shelf creating a natural harbour. The polar aircraft *Polar 2* and *Polar 4* and their crews (four pilots, three aircraft mechanics) were based at the GEISHA coastal base camp, in addition to the flight and camp coordinator, two technicians, one logistics manager, one radio operator, and one cook: totaling 13 people.

The Shackleton base camp, position 80° 44' S, 27° 11.5' W, was established in the mountains of the Shackleton Range. South of the camp, in „Gelnhausen Valley", a landing strip about 800 m long was marked by oil drums on a bearing of 80°. Because of the prevailing north winds, a second landing strip was made on a bearing of 10°. The geologists were distributed among several field camps (Aga, Maggy, Rosi, and Skidmore, Table 3), which were moved by sledge to different locations several times during the expedition. Their locations are shown in Figure 2. Altogether, 14 people worked in the Shackleton Range: nine geologists, two helicopter pilots, one helicopter mechanic, and two mountain guides. Because one of the geologists had been trained as a mountain guide as well, each field camp had its own guide. For the location of the field camps and the time of operation, see Table 3.

Date 1988	Lat.S	Long.W	Elevation (m)	Locality
SHACKLETON BASE CAMP				
10 Jan. - 17 Feb.	80° 41'	27° 14'	1350	Stephenson Bastion
CAMP AGA				
10 Jan. - 15 Jan.	80° 44'	25° 46'	1200	Hatch Plain
16 Jan. - 22 Jan.	80° 43'	24° 50'	1000	Watts Needle
23 Jan. - 30 Jan.	80° 51'	23° 30'	1200	Mount Wegener
31 Jan. - 09 Feb.	80° 17'	29° 38'	750	Haskard Highlands
CAMP ROSI				
11 Jan. - 16 Jan.	80° 44'	24° 48'	1000	Watts Needle
16 Jan. - 24 Jan.	80° 41'	23° 58'	1300	Escola Cirque
24 Jan. - 26 Jan.	80° 44'	25° 46'	1200	Hatch Plain
27 Jan. - 09 Feb.	80° 17'	29° 38'	750	Haskard Highlands
CAMP MAGGY				
10 Jan. - 16 Jan.	80° 44'	25° 00'	1150	Watts Needle
16 Jan. - 23 Jan.	80° 40'	23° 30'	1300	Mount Wegener
23 Jan. - 28 Jan.	80° 42'	29° 45'	1150	Otter Highlands
29 Jan. - 09 Feb.	80° 25'	29° 30'	760	Mount Provender
CAMP SKIDMORE				
09 Feb. - 11 Feb.	80° 18'	28° 50'	600	Mount Skidmore

Tab. 3: Position and period of service of the GEISHA field camps.

Tab. 3: Lage und Nutzungszeit der GEISHA-Feldlager.

During their flights to and from the Shackleton Range, the helicopters stopped for refueling in the Theron Mountains. A depot for Jet-A1 fuel and an auxilliary landing strip for the polar aircraft were established in the austral summer of 1986/87. Eight additional barrels of fuel were brought to this depot at the beginning of GEISHA.

Three depots were set up for refueling the skidoos, two in the Read Mountains and one on the upper Blaiklock Glacier. All depots were removed at the end of the expedition (Fig. 2).

RADIO COMMUNICATIONS

It was mentioned above that optimal planning and coordination of the supply flights with the fixed-wing aircraft were a prerequisite to avoid the risk of having to break off a flight and to prevent the consequent waste of fuel. Radio contact and exchange of weather data between the Shackleton and GEISHA base camps, as well as weather satellite images from the NOAA and METEOR satellites, were essential for planning the flight operations. The satellite images provided information about the cloud conditions in the area between the two base camps.

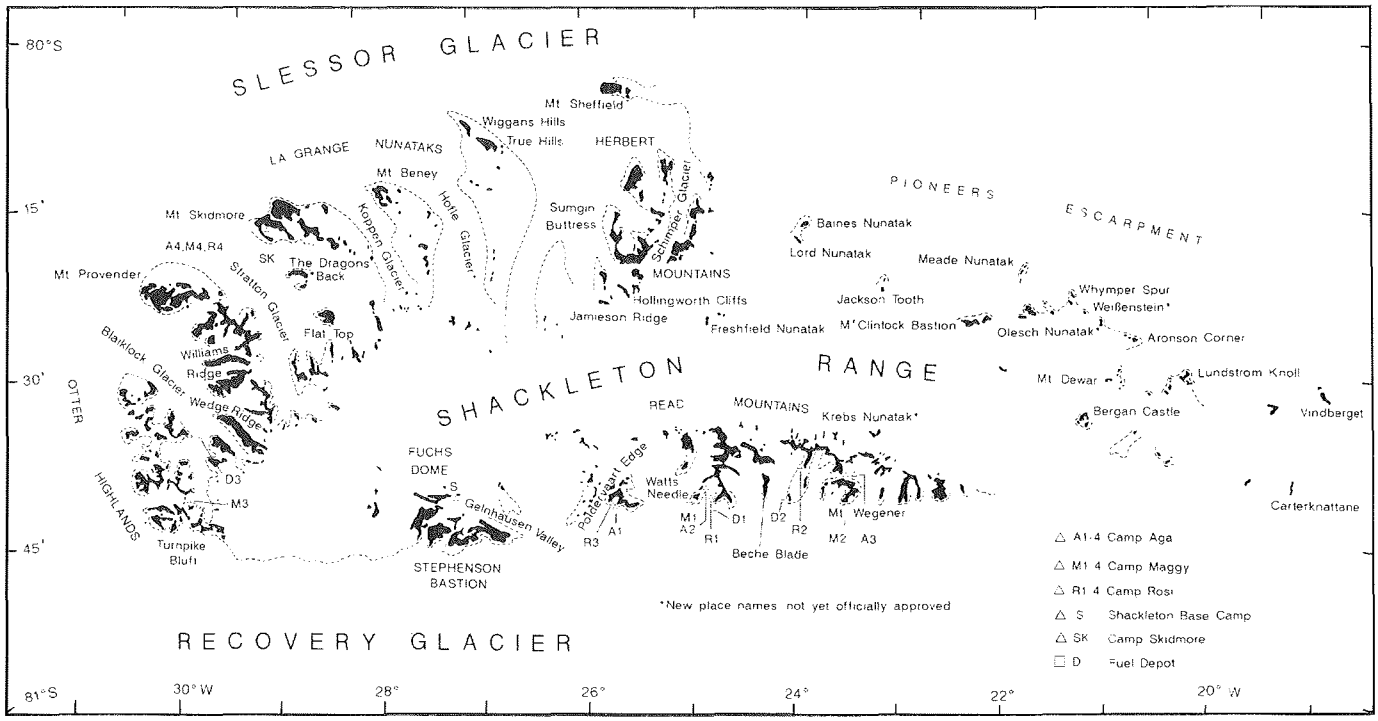

Fig. 2: Location of the fuel depots and field camps during GEISHA.

Abb. 2: Lage der Treibstoffdepots und der Feldlager während GEISHA.

The main radio station was installed at the Shackleton base camp. A 100-W variable frequency HF radio (Telefunken), a 20-W portable crystal-controlled HF radio (Stoner) and a 20-W VHF radio (Dittel) were used for ground to aircraft communication. From the Shackleton base camp, contact was maintained with the GEISHA base camp nearly 600 km away and the geologists' field camps. Radio contact with the *Polarstern* and Neumayer Station was possible sporadically.

At the GEISHA base camp, a 400-W Rhode & Schwarz radio, and a 20-W Stoner HF radio were installed in a Kässbohrer Pistenbully snow-trac. After moving the Pistenbully about 300 m away from the camp and the noise-producing generators, rather good radio communication was possible with the Shackleton base camp.

CONCLUSIONS AND RECOMMENDATIONS

The RV *Polarstern* interrupted the marine biological and geological programs on 16 February 1988 and returned to the Brunt Ice Shelf. GEISHA was terminated on 20 February 1988 after successful reloading of the equipment at the Windy Creek inlet, about 4 km northeast of Mobster Creek, where the relatively low edge of the Brunt Ice Shelf (only 16-17 m) made it possible to reload all the equipment on the RV *Polarstern*.

Favourable weather conditions and a smoothly working schedule made it possible to complete the field program in the mountains. A total area of about 15,000 km^2 (75 x 200 km) was covered sooner than expected. This made it possible to include the Herbert Mountains in our program, an area which was not considered in the original planning. This shows that in spite of the short time available for field work, the results were satisfying and the expedition successful.

No technical problems arose, apart from the need for two spare skidoo axels. There was a broad safety margin, as two helicopters were available and two fixed-wing aircraft could have been at hand at short notice, besides the back up of the RV *Polarstern* or the Halley Station.

But even good working conditions can be improved. One refinement would be to enhance the transport capacity of the polar planes to provide a better ratio of fuel transport capacity to fuel consumption per flight, making it possible to integrate at least one aircraft into an aerogeophysical program which would run concurrently with the geologist's work and the support flights. Bringing fuel into the Shackleton Range in advance to split the main logistics task from the scientific program would have been helpful, but was not a prerequisite for the success of GEISHA.

References

Bässler, K.-H. & Kothe, J. (1988): Geologische Expedition in die Shackleton Range: 3.7.2 Logistischer Rahmen.- In: D.K. FÜTTERER, D.K. (ed.), Die Expedition ANTARKTIS-VI mit FS „Polarstern" 1987/88.- Ber. Polarforsch. 58: 199-205.

Fütterer, D.K. (ed.) (1988): Die Expedition ANTARKTIS-VI mit FS „Polarstern" 1987/88.- Ber. Polarforsch. 58, 267 pp.

Roland, N.W., Kleinschmidt, G. & Buggisch, W. (1988): Geological Expedition to the Shackleton Range GEISHA 1987/1988, Nappe structures and a meteorite find.- BGR Circular 7: 3-20. Hannover.