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Weekly Report No. 3

(to the Amundsen Sea, West Antarctica)

27 February - 5 March 2006

This third week of our expedition was completely dedicated to exploring and surveying the continental shelf and parts of the mainland west of the Pine Island Bay which we could not enter last week. The region between Thurston Island and Ellsworth Land in the East and Marie Byrd Land in the West belong to the so-called Amundsen Sea Embayment. Coming from the interior of West Antarctica, several glaciers flow into here of which the Pine Island Glacier and the Thwaites Glacier are the largest. We now come to one of the main scientific goals of our expedition which circle around the understanding of the development of some very important parts of the West Antarctic ice-sheet and its future existence. Opposite to the mighty ice-sheet of East Antarctica, most of the West Antarctic ice-sheet lies on a rock surface several hundreds of meters below the sea-level. Already during the first expeditions in this region, it became obvious that only narrow ice-shelves exist at the foot of the glaciers around Pine Island Bay which is different as observed in the Weddell Sea or the Ross Sea. Measurements from satellites have revealed that these glaciers flow faster toward the sea and break off relative short after the grounding line, more than others do around Antarctica. Does this mean that the flow of parts of the West Antarctic ice-sheet is accelerated due to climatic or geological changes? A complete disappearance of the ice in the drainage area of these glaciers would let the global sea-level rise up to 0.5 meter. If the retreat of these glaciers results in a collapse of the West Antarctic ice-sheet as a consequence, global sea-level would rise to 5-6 meters. This is an extreme scenario, because it is still unclear what effects the accelerated flow-rates of the glaciers have on the behaviour of the remaining West Antarctic ice-sheet.

What can we do on board of a research icebreaker to help bring answers to the questions of a possible meltdown of the West Antarctic ice-sheet? We have several, partly international working groups on board who approach this problem with different methods. Three groups made use of the helicopters this week to fly to the area of Mount Murphy. Joanne Johnson and Terence O'Donovan of the British Antarctic Survey visited Turtle Rock to collect samples for 'surface exposure dating'. This is a useful technique for investigating deglaciations in West Antarctica. When cosmic rays penetrate rock, atoms of beryllium are produced. We can measure the abundance of beryllium within a rock, and this tells us for how long it has been exposed, rather than being covered by ice. If we obtain exposure ages for rocks from different heights on a nunatak, we can say how the surrounding ice has thinned over several thousands of years. Reinhard Werner of Tethys Geoconsulting in Kiel as well as Kristin Daniel and Andreas of University of Jena collected volcanic rock samples in order to extract information on the volcanic activity and the origin of the material erupted from the earth's mantle. The Marie Byrd Land region is littered

with volcanic cones which peaks pierce through the ice as so-called nunataks. Some geologists assume that the earth's crust underneath the ice-sheet is still volcanically active, which could contribute to the fast flow rates of the glaciers. The third group of Reinhard Dietrich and Andreas Richter, our geodesists of the Technical University Dresden, installed a GPS survey station on Mt. Murphy to measure, in a network with other GPS stations, the motion of the earth's crust. In addition to measuring the tectonic motion of Marie Byrd Land relative to other Antarctic regions, the so-called isostatic rebound can be determined. This is an uplift motion of the earth's crust resulting from the loss of weight of the ice-sheet becoming thinner since the last ice-age. All groups returned to Polarstern with happy faces expressing not only a successful sampling and installation program but also the enjoyment of the day out in the dreamlike and icy mountainous landscape on a sunny day.

The other geoscientific groups have also been busy this week with the collection of data and samples from the sea-floor. The goals are threefold and include the understanding of (1) the structure and evolution of the earth's crust, (2) the deposition of sediments which were transported by ice-sheet advance on the shelf, and (3) the retreat of the ice-sheet from the shelf since the last ice-age. When the first data are processed and analysed, more can be read about these research chapters of our expedition in the next letter.

Wonderful weather contributed even more to the excellent atmosphere on board. Weather was even topped on Saturday, making the celebration of the 3000th flight hour in the pilot life of our helicopter pilot Stefan Winter on the helicopter deck a perfect event.

With warmest wishes and greetings from all expeditioners

Karsten Gohl
(Chief Scientist)