CENTRAL AND SOUTHERN TRANSANTARCTIC MOUNTAINS REGION WORKSHOP

A. High priority science objectives

The highest priority can be attached to those aspects of the geology that make a unique contribution to earth sciences. These objectives provide the rationale for further research in the central and southern Transantarctic Mountains, and are listed below (NOTE that the topic areas have NOT been evaluated relative to each other and that these topics are NOT rank ordered).

1. Pre-Gondwana tectonic history. The SWEAT hypothesis is an example of application of the principles of plate tectonics to the Precambrian. The Neoproterozoic to Early Paleozoic record in Antarctica provides critical information for testing that hypothesis and understanding Rodinia- and Gondwana-wide tectonic events.

2. Biotic evolution and paleoclimates at high latitudes. Antarctica provides a unique opportunity to study a sedimentary sequence, deposited in a polar and near-polar position, that contains a nearly complete record of changes from "icehouse" to "greenhouse" conditions. This succession of upper Paleozoic to Mesozoic clastic sedimentary rocks contains exceptional vertebrate, invertebrate, plant and trace fossils. Fundamental questions concerning biotic evolution, the physical changes that occur during an "icehouse" to "greenhouse" transition, paleoclimate, paleoclimatic models, and tectonic evolution of southern Pangea can be addressed by studies of these rocks.

3. Magmatism and continental break-up processes. Assembly and break-up of supercontinents is a first order event in crustal history. The Ferrar tholeiites are an integral part of the flood basalt magmatism associated with the initial fragmentation of Gondwanaland. They contain unique information on source regions and evolution of mantle-derived magmas and their plumbing systems. They bear on the role of plumes, whether as heat sources alone or as heat and magma sources, plate-scale mantle processes, and the evolution of large igneous provinces (LIPs) in general. The tectonic setting of the linear belt of Ferrar tholeiites is critical in evaluating competing models for break-up processes.

4. Geodynamic evolution of continental rifts. The linked Transantarctic Mountains and West Antarctic Rift System, one of earth's major rift systems, have unique attributes that relate to intraplate deformation during Mesozoic break-up and subsequent rifting and uplift. These attributes include aspects such as the consistent asymmetry of the rift shoulder, the long duration of the crustal thickness and thermal boundaries between the two provinces, and the apparent aseismicity yet active volcanism, uplift and faulting. Furthermore, uplift is related to the glacial history and climate, which themselves have feedback into the denudation history.

5. Landscape evolution. Development of the landscape reflects the interplay of tectonics, climate and denudation. In the Transantarctic Mountains it links adjacent sedimentary basins to uplift of the range and to Cenozoic climate trends. The Transantarctic Mountains, and other high elevation ranges in East Antarctica, may be among the planet's least modified ancient mountain landscapes, parts of which may date from the Early Miocene or earlier. These mountains provide a unique window into Cenozoic history.

6. Cenozoic glaciation and climate history. Terrestrial sequences are an essential counterpart to marine sequences in the study of glaciation and climate history. The Sirius Group, with the most diverse geomorphic settings of any glacial unit in the Transantarctic Mountains, has been interpreted in terms of a dynamic East Antarctic ice sheet which attained its present state during mid-Pliocene cooling; this contrasts with the conventional view of long-term stability with the present polar conditions and East Antarctic ice sheet existing essentially unmodified since the early Miocene. These contrasting hypotheses have profoundly different implications for the course of Cenozoic climate.