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# Brittle Deformation Events in the Lambert Glacier Region (East Antarctica): Insights into the Tectonic Control on the Formation and Evolution of the Lambert Graben

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**Abstract** - The brittle structural architecture and tectonic history of the southern Prince Charles Mountains (PCM) in the Lambert Glacier region was studied by applying classic fault-slip analysis. Our data point to the presence of three brittle deformation events. The oldest event involves E-W to NE-SW directed contraction of uncertain, but likely pan-African age; reverse faults and co-genetic folds related to this event are overprinted by extensional faults attributed to the formation of the Lambert Graben. This roughly E-W directed extension together with co-genetic large-scale dextral transtension parallelling the main NNW-SSE oriented axis of the Lambert Graben (*i.e.* parallel to the Mawson Escarpment) is tentatively related to the Cretaceous break-up of Gondwana and the separation of India from Antarctica. The youngest brittle deformation event observed in the southern PCM is related to NW-SE directed contraction and co-genetic NE-SW extension. It is responsible for reactivation and reversal of the Cretaceous major faults and also for present-day geomorphology in the Lambert Glacier region.

## INTRODUCTION

The 40-50 km wide and approximately 500 km long Lambert Glacier in East Antarctica represents the world's largest glacier system. Its ice streams roughly follow an old, pre-glacial depression and one of the major crustal structures of East Antarctica: the Lambert Graben (Fig. 1). The Lambert Graben (*e.g.*, Crohn, 1959; Trail, 1963; Wellman & Tingey, 1976; Hofmann, 1991; Arne, 1994; Mishra et al., 1999) is generally interpreted as a failed rift that extends from Prydz Bay at the Antarctic coast inland into the Antarctic continent over a distance of approximately 700 km. Its formation and present structural architecture is generally attributed to the Cretaceous break-up and fragmentation of Gondwana in the Indian-Antarctic sector (Hofmann, 1991; Mickhalsky et al., 1992; Arne et al., 1993), however, still older (particularly Late Palaeozoic) rifting events are assumed (Arne et al., 1993; Mickhalsky & Sheraton, 1993). The Lambert Graben represents a typical half-graben structure with rather complicated internal structure involving thinning of the continental crust in the centre of the graben to approximately 25 km from its original thickness of 35-40 km and filling of the depocentre with a 5-10 km thick pile of sediments (Fedorov et al. 1982). The Phanerozoic rifting processes in the Lambert Graben are interpreted to be the main reason for uplift and erosion of the southern Prince Charles Mountains (PCM), the main target area of PCMEGA, which represent the only area within Antarctica where rocks are accessible that far inland.

One of the major aims of PCMEGA was focused on brittle deformation events linked to the development of the Lambert Graben and to possibly still older events. The latter, for instance, could be related to Late Proterozoic to Early Palaeozoic tectonics, since structural and geochronological evidence for regional Pan-African deformation was recently reported from the northern PCM (*e.g.*, Boger et al. (2002). Or they could be related to Mesoproterozoic orogenic events that are well documented in the PCM and are related to the collision of Proto-India and Proto-East Antarctica (Sheraton et al., 1996; Mezger & Cosca, 1999; McWilliams, 1981; Yoshida et al., 1992; Powell et al., 1993), although this seems to be rather unlikely in our opinion.

The structural data on brittle deformation were collected in different subareas in the expedition area covering a wide variety of lithotectonic units (Fig. 2). These subareas were in particular:

(1) Mt. Stinear and Mt. Rymill;
(2) Rofe Glacier (northern Mawson Escarpment);
(3) Cumpston Massif;
(4) Tingey Glacier (southern Mawson Escarpment);
(5) Mt. Ruker and Mt. Rubin.