Continental Collision in New Zealand

F J Davey, GNS Science, New Zealand.

Seismic data recorded across the South Island of New Zealand image the result of the transpressive continental collision of the Pacific and Australian plates during the past 5 million years. Prior to this the plate boundary was largely transcurrent for over 10 My. The South Island provides a relatively simple tectonic environment in which to study the processes and deformation associated with continental collision. Although the central part of the South Island has been taken to represent a simple, 2D convergent continental plate boundary, more detailed investigation demonstrates that the deformation is 3D in nature, resulting from the transpressive plate motion. Continental collision is accommodated by the ramping up of the Pacific plate over the Australian plate. This initial asymmetric deformation may be defined by an initial difference in lithospheric strength (Australian plate stronger than the Pacific plate) or an inherited suture resulting from earlier plate motions. Evidence supports both explanations and the real cause may be some combination of both. The ramping up of the Pacific plate is accompanied by the delamination of the Pacific plate which results in the uplift and exposure of mid-crustal rocks at the plate boundary fault (Alpine fault) that form a foreland mountain chain with a thick crustal root (additional 8 - 10 km) consisting of the delaminated lower crust and a thickened overlying middle crust. Lower crust varies in thickness along the orogen, which may arise from convergence in and lower lithosphere extrusion along the orogen. Low velocity zones in the crust occur adjacent to the plate boundary (Alpine fault) both in the Australian and Pacific plates. Fracturing of the upper crust as a result of flexural bending is proposed as the cause for the low velocity crust in the Australian plate. The low velocity zone in the Pacific plate at the plate boundary is probably caused by high pressure fluids in the crust derived from prograde metamorphism of the crustal rocks as they are being exhumed, an explanation supported by high conductivity measurements in the same region from magnetotelluric measurements. The structure of the orogen forming the Southern Alps conforms to theoretical models and numerical models showing an uplifted region constrained by the major ramp fault and antithetic faulting. Some comparisons with the convergent tectonics of Taiwan may be made