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River drainage evolution in an active mountain belt, New Zealand

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The Southern Alps of New Zealand have developed at an active oblique collisional plate boundary. The river drainage systems are evolving as a result of ongoing deformation imposed on inhomogeneous Mesozoic crust, and as a result of differing interactions of rivers with active structures in different parts of the orogen. Process, timing, and order of some Quaternary drainage reorientation events can be constrained using distribution and genetics of freshwater fish. A wide (200 km) relatively low relief (<1800 m) orogen has developed on thick schist basement (>30 km) since the Miocene. The schist drainage system is dominated by synformal basins separated by antiformal ranges. Progressive tightening of these folds results in stream capture and drainage reorientation. Deformation of thinner (<25 km) greywacke-dominated crust resulted in a narrower (50 km) orogen with high mountains (>3000 m), with most uplift from Pliocene-Recent. Rivers on the eastern (rainshadow) side of the narrow orogen drain southwards, oblique to the orogen axis. This portion of the orogen has become progressively wider (>100 km) since the Pliocene, with development of inland basins and more complex drainage systems associated with active fault motion. Rivers on this eastern portion of the orogen are also being passively translated southwestwards, parallel to the plate convergence vector, into the drainage divide region. Rivers on the western high-rainfall side of the orogen are short and steep, and flow perpendicular to the orogen axis. Rapid headward erosion of the western drainages causes capture of eastern rivers and ultimately reorientation of drainage from inland basins. The northern portion of the Southern Alps is being overprinted by a set of northeast striking strike-slip faults that are evolving southwestwards and stepping progressively southwards. Erosion along these faults is imposing a new topographic grain on the orogen and is causing drainage reorientation as relict south-trending valleys are overprinted by northeast-trending valleys. The combination of passive drainage translation, river capture and erosion from the west, and structural overprinting from the northeast, will obscure the original drainage geometry on the greywacke basement over the next 2 million years.