The 3D evolution of localised and distributed strike-slip shear zones, visualised by X-Ray CT scanning

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Strike-slip systems can accommodate hundreds to thousands of kilometres of horizontal displacement by simple shear. These systems are prone to high earthquake risk and understanding their structural geology will assist with hazard mapping and future risk mitigation. Deformation by simple shear can be concentrated on a single fault or distributed over tens to hundreds of kilometres. It is usually challenging to understand the complex geometries that form in strike-slip systems by analysing finite strain in simple horizontal and vertical sections observed in the field. To understand the fundamental processes that form such system, geologists use analogue experiments to test the development and evolution of structures through time. The internal 3D evolution of deformation within analogue models of simple shear is often inferred by changes in topography and by using Particle Image Velocimetry (PIV) to analyse changes in incremental and finite strain on the model surface, similar to horizontal outcrop and map patterns, except showing the evolution of these features through time. Cutting vertical cross sections through a simple shear experiment at specific time steps to reveal its 3D geometry is not an option when using granular materials to represent upper crustal deformation. In this study, we use X-Ray Computed Tomography (CT) scanning to analyse the 3D evolution of strike-slip fault systems in granular materials without disruption to the analogue experiments. We present results of the 3D evolution of localized and distributed simple shear zones by CT scanning analogue experiments at regular intervals. Localized and distributed strike-slip shear zones are generated in an analogue shear box by using stretchable fabric to adjust the basal boundary conditions. The results are compared to the Marlborough Fault System; a system of strike-slip faults that form the Australian – Pacific plate boundary in northeast South Island, New Zealand.