

Geology of the Earthquake Source:
A Volume in Honour of Rick Sibson

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Geology of the Earthquake Source:
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Preface

'Never came reformation in a flood, with such heady currance, scouring faults'

W. Shakespeare – King Henry Vth

In early 2009, Emeritus Professor Richard (Rick) H. Sibson retired from most active teaching in the Department of Geology at the University of Otago, New Zealand (Fig. 1). Rick is an extraordinary teacher, who enjoys putting on a 'show', where impeccably presented science is peppered with judicious use of quotes from the classical literature (and well-directed chalk). His series of introductory lectures to first-year students at the University of Otago, which focus on earth resources and their depletion, has, over the years, inspired many to pursue a Geology major. At higher levels, he has ensured students have a solid grounding in problem solving from a quantitative standpoint, and rigorous training in the principles of structural geology. He has also supervised a number of graduate students, all of whom have benefited from his suggestions to think about the implications of their research in a wider context and most of whom have gone on to hold high-profile positions in academia or industry.

Furthermore, during his teaching and research career, Rick revolutionized the understanding of faulting processes, earthquakes and fluid flow in the Earth's crust, and pioneered the integrated interpretation of fault dynamics, earthquake mechanics and fluid–rock interaction. Through a series of landmark publications over the past 35 years, he has significantly influenced global research directions in the fields of structural geology and seismotectonics.

Rick was born and raised in Auckland, New Zealand. His early education at Kings College was supplemented by interaction with his uncle, renowned naturalist Charles Alexander Flemming, and by his father, a Classics teacher and amateur ornithologist; we suspect numerous bird-watching trips in place of summer holidays prompted his interest in Geology, which is difficult to pursue in swamps. After graduating with a BSc(Hons) in Geology from the University of Auckland in 1968, Rick moved to Imperial College London, where he obtained MSc and PhD degrees. His PhD research on exhumed fault rocks from the Outer Hebrides Fault Zone precipitated his efforts to integrate structural geology and seismology – in what has now

become the interdisciplinary field of earthquake science. It was here that he recognized pseudotachylite as the friction melt formed in ancient earthquakes, and that the idea of thermal pressurization as a fault-weakening mechanism was born.

Rick's geological field observations in the Outer Hebrides led to the idea that the base of the crustal seismogenic zone may be controlled by the depth of the brittle–viscous transition in the dominant mineral phase. He tested this idea against geophysical data by collating earthquake locations during a year-long visit at the US Geological Survey in 1981. His papers that deal with the relative importance of brittle and ductile deformation, and the seismic style of crustal faults – written under the influence of his colleagues at Menlo Park during this time – are still frequently cited today.

After his time at USGS, Rick moved to University of California at Santa Barbara, where he stayed until he moved back to New Zealand in 1990, to become Head of Department of Geology at the University of Otago. Students at both of these universities have benefited from Rick's dedication to teaching, and from the geological insights he has shared with undergraduate and graduate students through the years. His teaching drew heavily from his research interests; one could say he was a pioneer of the concept of 'research-informed teaching'. His insights into active fault-zone processes and his ability to link active deformation to observations in exhumed fault zones has become a framework not only for understanding earthquake mechanics, the extent of the seismogenic zone and the fault reactivation during tectonic inversion, but has also been successfully applied to economic geology and the understanding of fault-hosted hydrothermal mineralization. The 'fault valve' theory has been particularly useful for understanding the interplay between fluid flow and local stress regimes, in light of the transient permeability changes intimately linked to the earthquake cycle.

To recognize Rick's considerable scientific contributions during the course of his teaching career, a special symposium, 'Geological and Geophysical Signatures of Earth Deformation and Fluid Flow', was held as part of the Geosciences '09 conference in Oamaru, New Zealand, 23–27 November 2009. This Special Publication is partly based on papers presented in this workshop, but also contains



Fig. 1. Rick after a hang-glider flight at Coronet Peak, Central Otago, New Zealand (photograph courtesy of Simon Cox).

contributions from authors who were not able to participate in the symposium and now join in celebrating Rick's career through their participation in this dedicated volume.

We are grateful to the University of Otago for funding in support of the symposium at Geosciences '09, to the convenors (Phaedra Upton and Virginia Toy) and organizing committee of Geosciences '09, without whom the symposium, and consequently this volume, would not have been possible, and particularly to Rick's numerous colleagues for participating in the symposium. We also wish to

thank all the reviewers who volunteered their time to improve the papers in this volume; their effort is greatly appreciated.

Finally, although Rick has retired from his teaching post at the University of Otago, he is still an active participant in our scientific community. We eagerly anticipate the research he will publish in coming years.

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