Energy and Minerals Research Fund - 2015 Science Investment Round Successful Proposals

Short title	Organisation	Term (yr)	Total funding (excl GST)	Summary
Understanding petroleum source rocks, fluids, and plumbing systems in New Zealand basins: a critical basis for future oil and gas discoveries.	GNS Science	4	$9,600,000	Our research programme will develop valuable new insights into oil and gas occurrence in New Zealand's 18 recognised petroleum basins through integrated studies of petroleum source rocks, fluids and subsurface fluid migration (plumbing) systems. Our results will provide critical knowledge to help explorers to more effectively predict, target and find new petroleum fields. World demand for oil and gas continues to grow, with more gas now replacing coal as we transition to a fossil fuel-free future. New home-grown discoveries will materially improve our nation's wealth, prosperity and energy supply and improve our competitiveness in the global economy. Oil and gas (petroleum) are initially formed by the geological burial, maturation and geochemical conversion of organic-rich sedimentary source rocks, then expelled into surrounding strata, whereupon they flow upwards (through buoyancy) if there are suitable fluid migration pathways within and between the rock layers. If impermeable barriers are encountered the oil and gas flow can be impeded and focused into traps (a process called "charge"), thereby forming oil and gas fields. New Zealand's basins are geologically very complex and exploration success has been mixed. The quintessential question and pre-drill technical uncertainty still faced by explorers here is whether or not large volumes of petroleum have been generated in their area of interest and where is it now? We will address this conundrum by applying state-of-the-art research tools and technologies to assess the likely presence of effective source and charge in our established and frontier basins. We will pursue three main lines of investigation: 1) source rock distribution, type, and petroleum potential; 2) genetic and spatial relationships between oils, gases and their source rocks; and 3) the dynamic movement of petroleum through subsurface strata. Using existing and new techniques we will analyse samples from outcrops and exploration wells, combined with advanced subsurface mapping, to improve our baseline geological, geochemical and geophysical databases. Our interpretations will incorporate empirical calibration to known oil and gas fields in Taranaki Basin and extrapolation of concepts to frontier basins. We will also integrate results of parallel research into other unique elements of our petroleum systems being undertaken within other GNS Science programmes. The research team is highly specialised and multi-disciplinary, and includes collaborators within several New Zealand universities (Auckland, Canterbury, Otago and Victoria), the Institute of Environmental Science and Research (ESR) and overseas institutions (UK, Germany, Ireland and Norway). The main users of our research are the petroleum industry and central government (NZP&M). We will deliver our results freely via industry conferences, digital data products, science reports, scientific journals and the internet (e.g., our Petroleum Basin Explorer portal). We will produce outputs compatible with the needs of government, including derivative products in GIS format, to attract more exploration investment here. We also plan to engage with iwi and other stakeholders to interactively discuss the broad geological fundamentals and technical aspects of petroleum exploration. The intent is to foster informed dialogue concerning offshore petroleum exploration activity, leading to improved understanding of the risks, consequences and scale of potential benefits.
Cretaceous tectonic transition from convergence to extension in New Zealand: Implications for basin development, paleogeography and hydrocarbon plays.	University of Waikato	4	$2,409,172	The aim of this research is to develop a comprehensive understanding of the timing of geological changes that occurred during the mid to Late Cretaceous Period (c. 115 – 65 Ma) when many of the large scale features of the New Zealand subcontinent (Zealandia) developed, evident in its present-day bathymetry – basins (Bounty Trough; New Caledonia Basin) and ridges (Challenger Plateau; Chatham Rise). During the Early to mid Cretaceous the New Zealand margin of Gondwanaland was characterised by the formation of an elevated active continental margin, crustal shortening and thickening being driven by subduction of ocean lithosphere. The crustal thickening occurred via reverse faulting and subduction processes in the forearc region, such as sediment accretion and sediment underplating beneath an accretionary wedge underlying the continental shelf and slope, parallel to, and immediately east of the contemporary trench. Changes in the forces involved in the interactions between the plates, driven from outside the New Zealand region, changed the balance between various forces within the continental margin, leading to horizontal extension, initially within the arc and back arc regions. Extension acting over a period led to the formation of large basins, which gradually subsided below sea level, in turn attracting sediment from rising intervening ridges. The present understanding is that the Cretaceous transition from shortening to extension was geologically instantaneous at c. 105 Ma; our hypothesis, by contrast, is that this change in stress varied in time and space across and along the

				continental margin and occurred over an interval (c. 115-85 Ma). To test our hypothesis we will apply several radiometric dating methods (U-Pb, fission track and Helium dating) to zircon and apatite crystals separated from basement rocks as well as Cretaceous sediments, to estabish the timing of geological events, including basin formation. These methods are internationally state of the art and we have the analytical facilities in place in our University of Waikato laboratories to undertake this work. The results of our research will be of interest to petroleum exploration companies seeking to evaluate the hydrocarbon prospectivity of New Zealand's sedimentary basins, companies consulting to exploration companies, New Zealand Petroleum & Minerals (MBIE), who promote and regulate exploration activity in New Zealand's Exclusive Economic Zone, and researchers in institutions in New Zealand and overseas. Our research results will be made public as they are produced via conference presentations, meetings with companies, reports submitted to the Petroleum Report Library (NZ Petroleum & Minerals) and papers to scientific journals for peer review.
Total over 4 years			**$12,009,172**	