

# BASIN MODELLING IMPROVES PROSPECTIVITY OF NORTHLAND BASIN, NEW ZEALAND

D Burggraf<sup>1</sup>, G Cable<sup>2</sup>, R Herzer<sup>3</sup>, T Iguchi<sup>4</sup>

<sup>1</sup>Conoco Inc, P O Box 2197, Houston, Texas

<sup>2</sup>Consultant, 716-F Country Place Drive, Houston, Texas

<sup>3</sup>Institute of Geological and Nuclear Sciences, P O Box 30368, Lower Hutt

<sup>4</sup>Nippon Oil Exploration, 1-18-1, Shimbasu, Minatoku, Tokyo 105

## Abstract

Integrated interpretation of geological (seismic and well log) data and modelling applications encompassing the Northland and Taranaki basins indicates that the offshore Northland Basin has significant potential for petroleum exploration. Paleotectonic reconstructions indicate that the Northland Basin and Taranaki Basin likely had similar evolutionary histories, possibly existing as one large basin complex during the late Mesozoic and early Tertiary as New Zealand rifted from the Gondwana supercontinent. This similarity stimulated a recent in-depth study of the Northland Basin because of the petroleum potential that may lie beneath the untested offshore waters.

The complete lack of well control in the offshore Northland Basin forced the use of several indirect methods to evaluate the basin. Seismic data was correlated with DSDP hole 206 in the New Caledonia Basin, and with well control in the Taranaki Basin to extrapolate the stratigraphy into the Northland Basin. Gravity modelling was used to estimate the thickness of sediments beneath the Northland Allochthon and the Lower Miocene volcanic interval which prevents seismic imaging of deeper strata. Maturation modelling was used to predict the probable thermal maturation history for the possible source facies in the lower Paleogene and Upper Cretaceous section in the Northland Basin.

Results to date indicate first, that Northland Basin seismic data confirms a similar, but older, stratigraphic development to that of the Taranaki Basin. A middle Cretaceous "syn-rift" phase is indicated by an asymmetric graben-fill section exhibiting angular discordance with the overlying Upper Cretaceous and Eocene-Paleocene "post-rift" sediments. One major difference between the two basins is the increased marine character of the "syn-rift" sediments in the Northland Basin compared with the dominant terrestrial-lacustrine nature of the Taranaki Basin "syn-rift" section. Second, the geometry of the Northland Basin is asymmetric with the thickest sediment fill (up to 12 km, including the Murihiku sediments) lying along the eastern basin margin in a coast-parallel, narrow trough that is coincident with the isopach thick of the Northland Allochthon and Lower Miocene volcanics. To the west of the trough, the sediments thin irregularly over a series of coast-parallel, horst and graben blocks with the western basin limits remaining undefined. Third, organic maturation modelling shows that the Northland Basin equivalents of known hydrocarbon source rock horizons in the Taranaki Basin (Upper Cretaceous "syn-rift" Pakawau Group and "post-rift" Eocene-Paleocene Kapuni Group) and East Coast Basin (Paleocene Waipawa Black Shale) are fully mature in the thick sediment trough that parallels the coast. Broad areas to the west of this "trough" also indicate that at least the Upper Cretaceous "syn-rift" section is in the peak-oil stage of maturity. Confidence in these maturation interpretations was provided by the calibration of the Northland Basin paleo heat-flow model with measured maturation data (vitrinite reflectance) from wells in the Taranaki Basin. Mapping of modelled results also helps to explain known oil and gas occurrences in the Taranaki Basin.

## Authors

**GREG CABLE** is a graduate of the University of West Virginia (AB) and the University of South Carolina (MSc), and has more than 16 years of oil and gas exploration experience (15 years with Conoco) in North America, the Far East and Pacific region, Africa and Russia. Mr Cable is currently a consultant continuing to focus on South East Asian exploration.

**DAN BURGGRAF JR** is a graduate of Lehigh University (BSc) and Iowa State University (MSc), and spent about 4 years in mineral exploration with Conoco, before joining the Petroleum Exploration Research Division in 1984. For the past 6 years, Mr. Burggraf has worked in international exploration focusing on applied geochemistry and basin modelling.

**RICK HERZER** is a graduate of Queens University, Ontario (BSc Honours), University of British Columbia (MSc), and Victoria University of Wellington (PhD). He is currently working for the Institute of Geological & Nuclear Sciences Limited.

**TAKASHI IGUCHI** is a graduate of Tokyo University (BSc) and joined Nippon Oil Exploration Limited in 1992. Prior to joining Nippon Oil, Mr Iguchi was involved in coal geology (Mitsui Mining) and later petroleum exploration (Mitsui Oil Expl.), and has worked on projects in Japan, Indonesia, Thailand, U.S.A., and Australia. Mr Iguchi is currently Assistant Manager, Exploration Department with Nippon Oil Exploration Ltd.