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Recent Experiences in using TOUGH2 for Geothermal Modelling

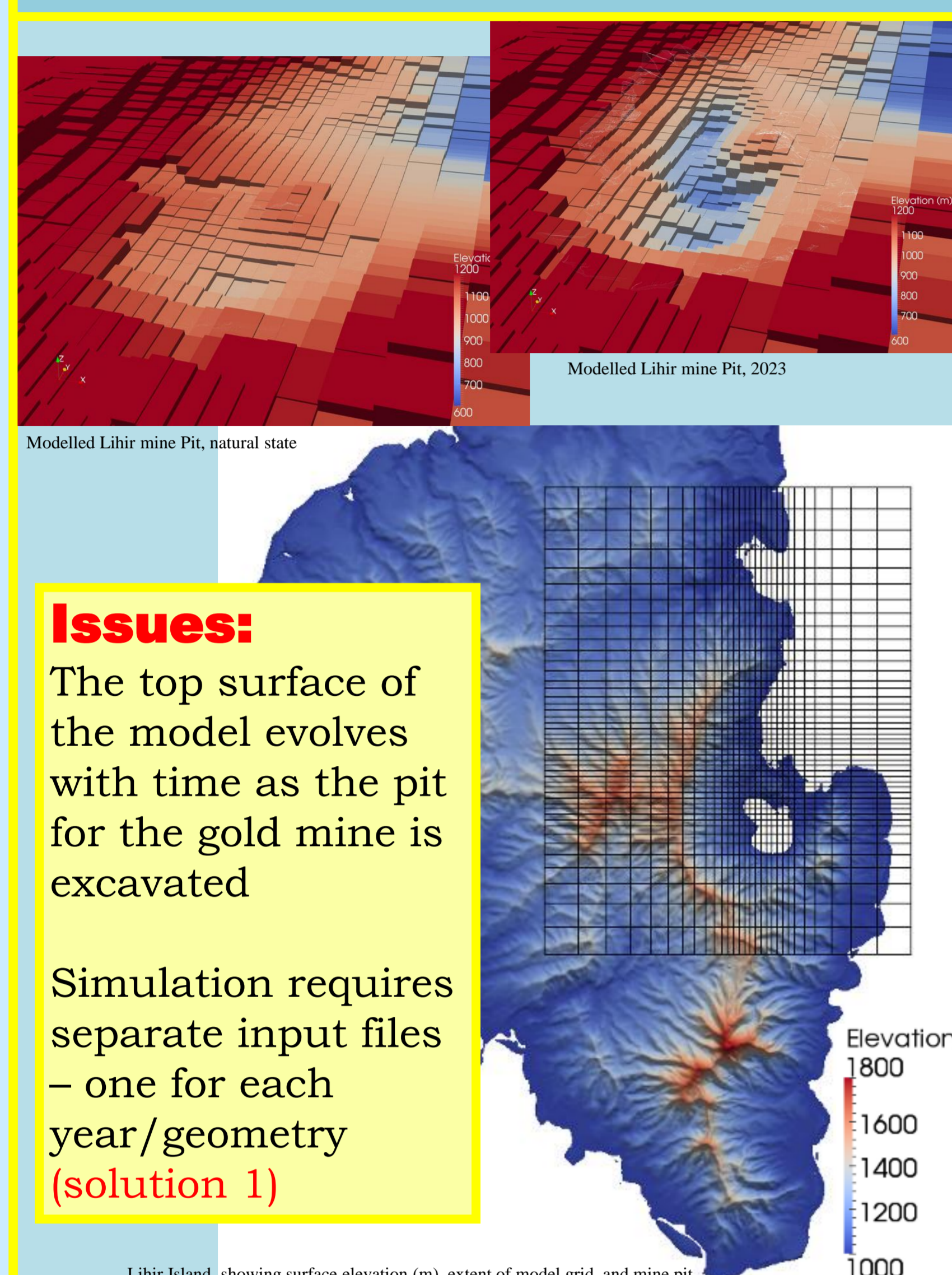
E.K. Clearwater, A. Yeh, J.P. O'Sullivan, E. Kaya, A.E. Croucher, T. Cui, M.J. O'Sullivan, S.J. Zarrouk, J.J.C. Austria, A.E. Ciriaco, R. Archer and D. Dempsey

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Introduction

The geothermal modelling group in Engineering Science (University of Auckland) is involved with several geothermal R&D projects. On the development side we are running models of Ohaaki, Wairakei, Ngawha, Reporoa, Wayang Windu and Lihir. Our experiences in these projects have led on to several parallel research projects, which help to overcome the various modelling issues encountered.

Lihir



Solutions!

1. Pytough

This is a set of python software routines we have developed to allow control over all aspects of a TOUGH2 simulation.

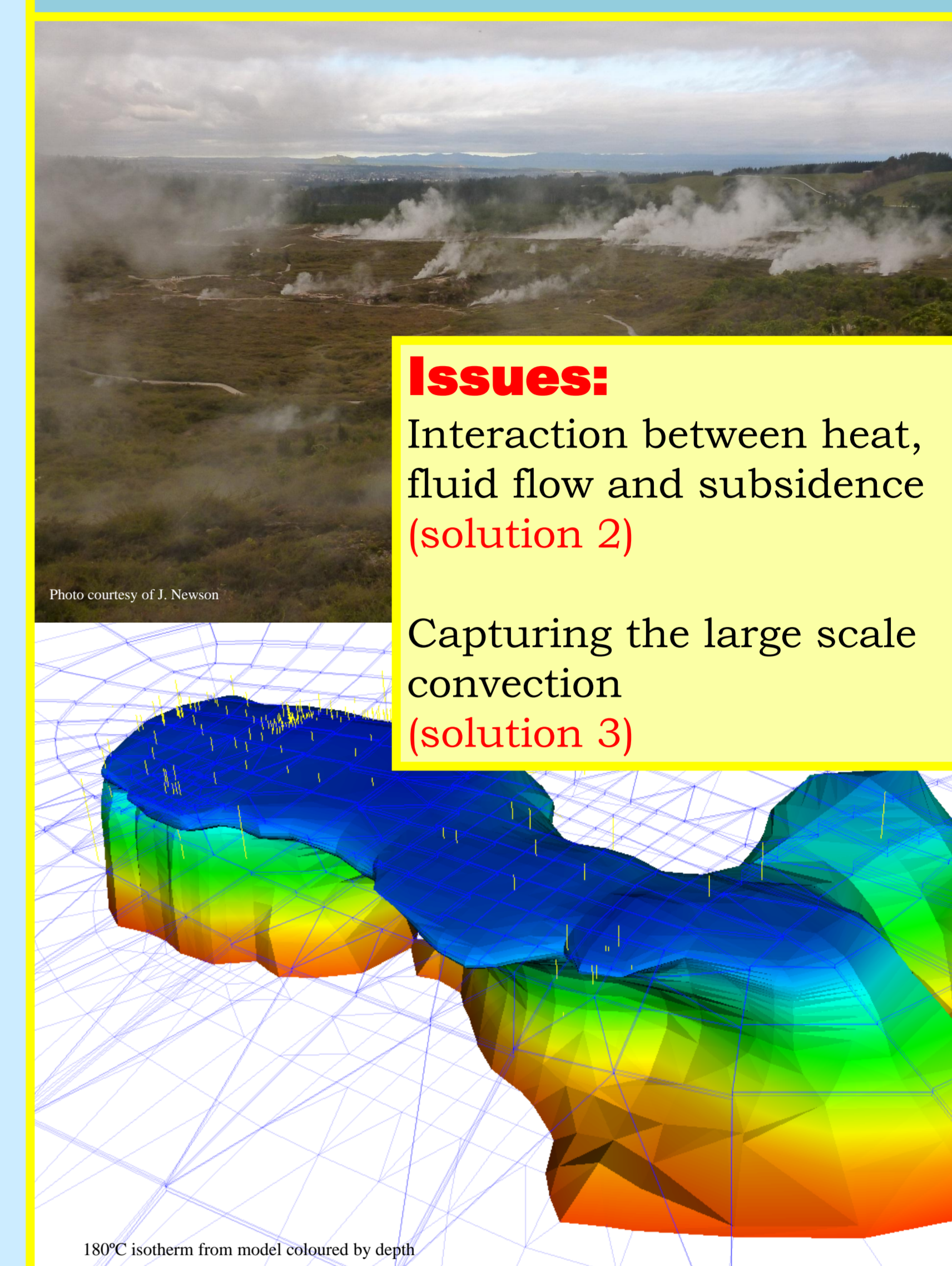
This library can be used to automate the creation and editing of TOUGH2 model grids and data files (work that is usually manual, labour intensive and error-prone), as well as execution, display and analysis of model simulation results.

2. Fluid/Rock Interaction

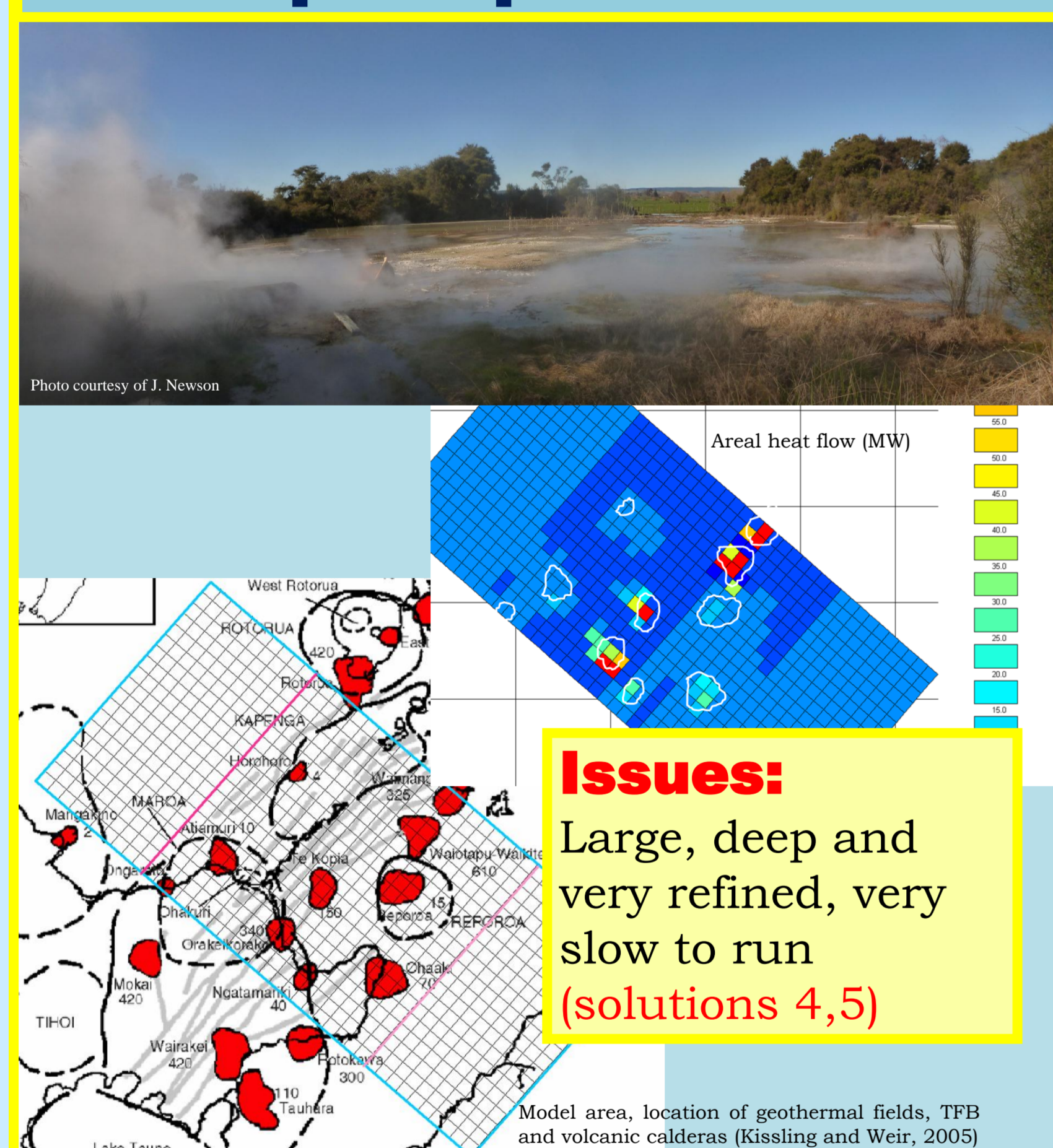
We are carrying out miscellaneous studies of reservoir physics, several of which involve fluid/rock interaction.

For example - the effects of cold-water injection on permeability and subsidence in geothermal fields.

Wairakei



Taupo-Reporoa Basin



3. Hotter and Deeper

Our reservoir models have led to studies of more generic convection and studies of larger areas of the TVZ as well as deeper models.

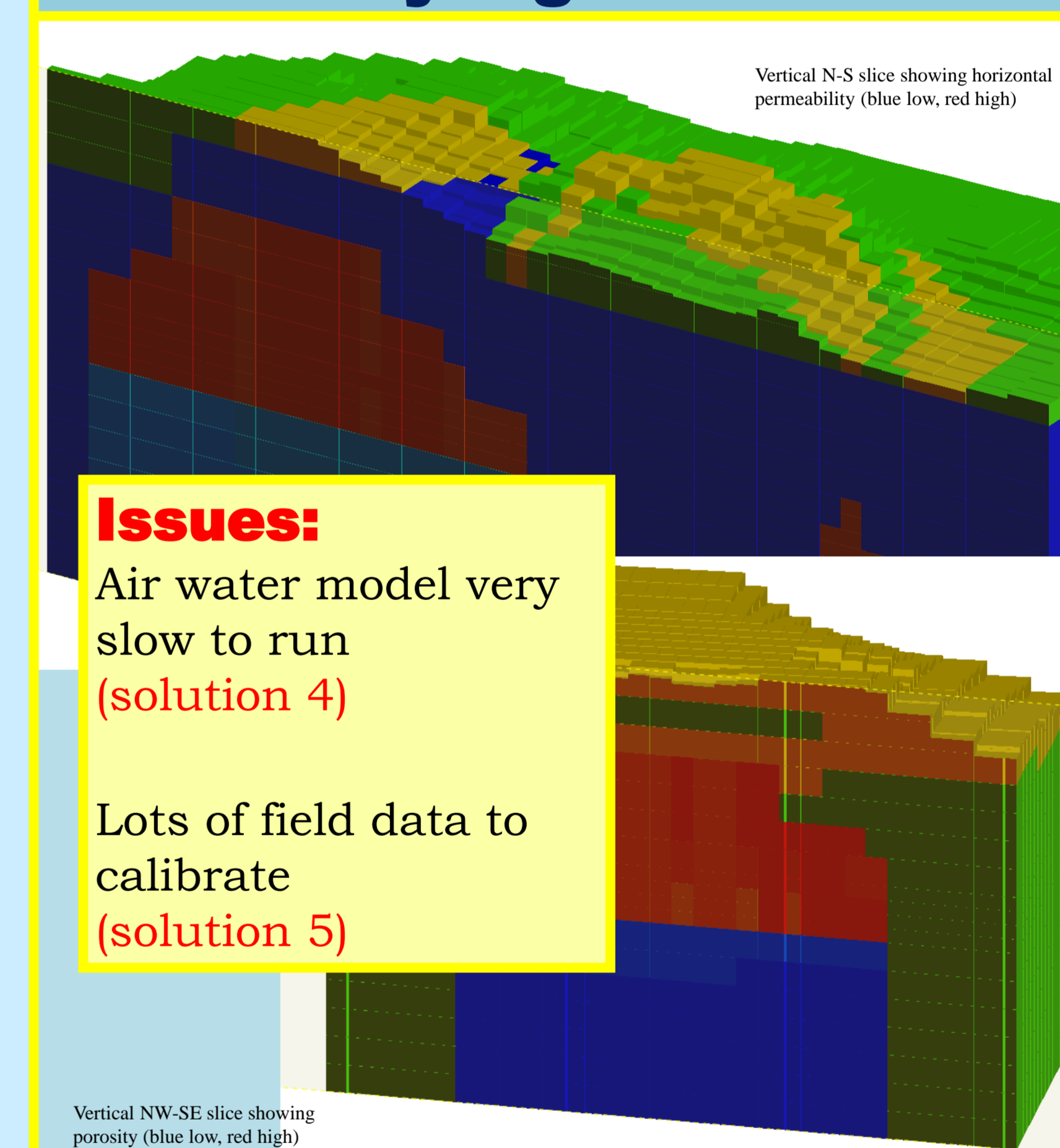
We have developed a supercritical version of TOUGH2 based around the updated IAPWS-97 thermodynamic formulation.

This code is for pure water only, and we wish to extend it to include CO₂ and NaCl.

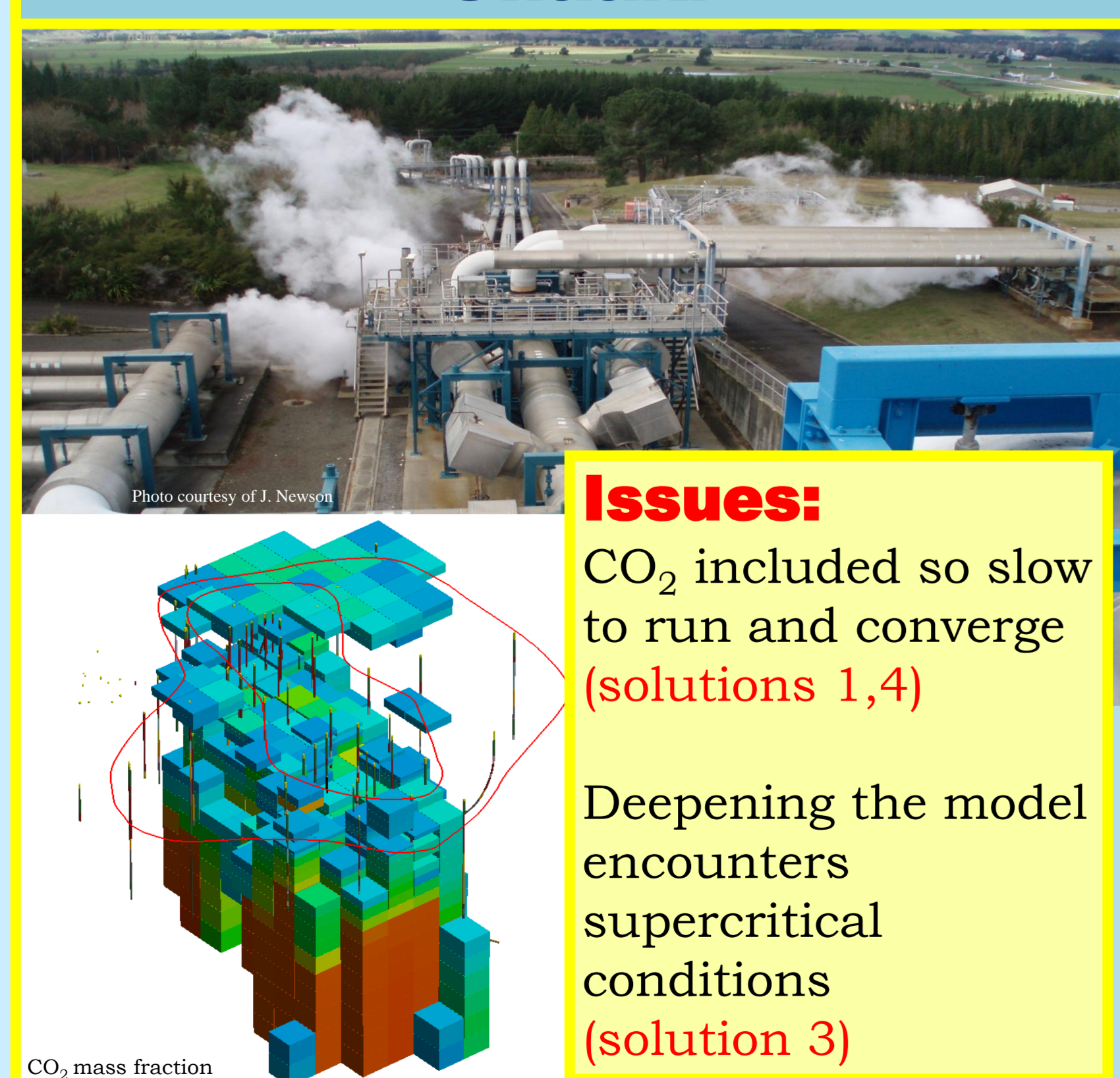
4. TOUGH2 Memory and Speed Limits

We have modified the AUTOUGH2 (Auckland University's version of TOUGH2) code to make memory use more efficient by making the memory allocation dynamic, and recompiled it as a 64-bit executable.

Wayang Windu



Ohaaki



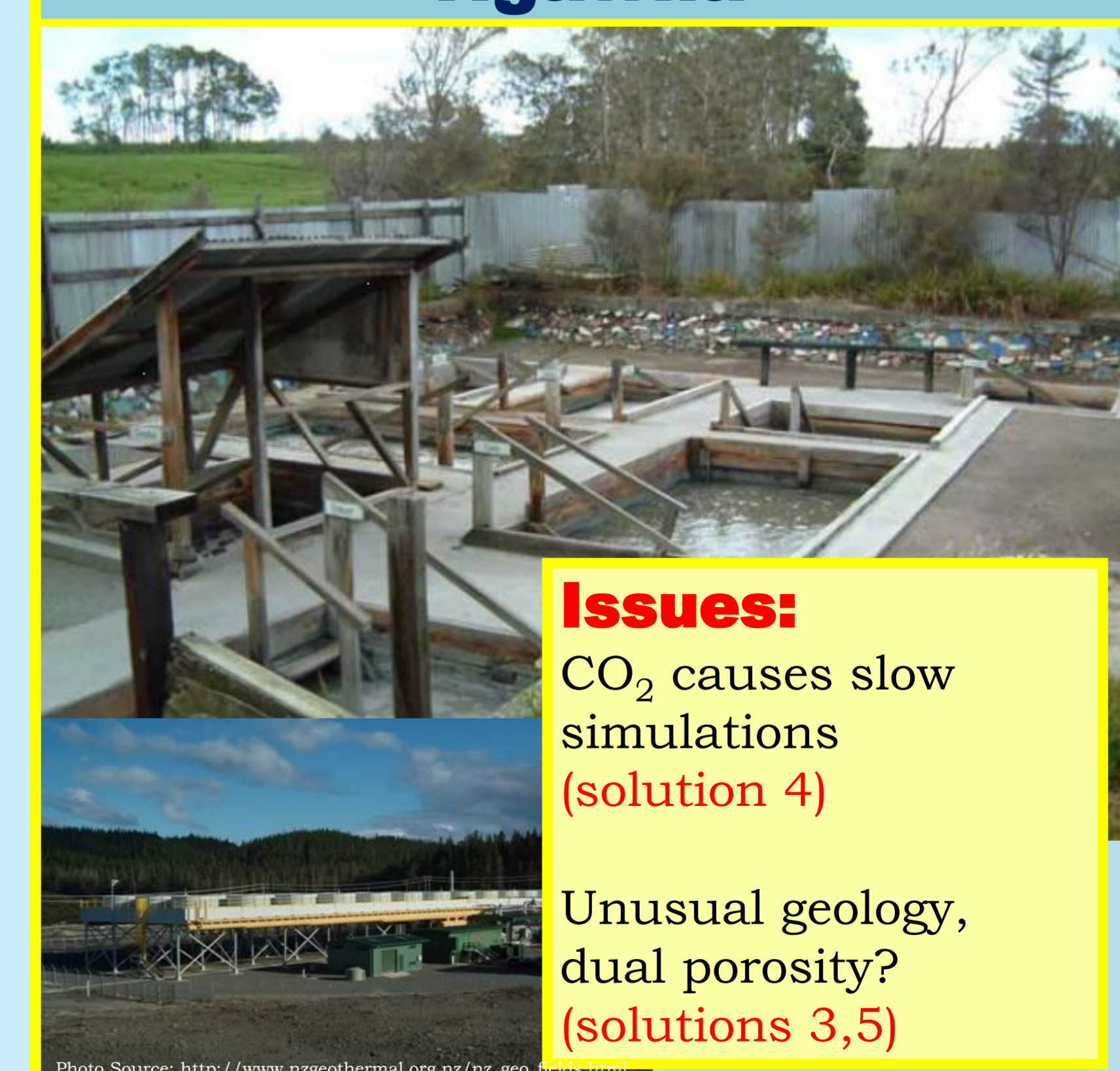
We are also routinely using the parallel simulation code, TOUGH2-MP, which divides a model up into sub-domains, each running on a separate processor.

5. Inverse Modelling

We have carried out studies using inverse modelling with iTOUGH, PEST and Markov Chain Monte Carlo methods (MCMC).

These allow us to quantify the uncertainties associated with parameter distributions within reservoir models.

Ngawha



Acknowledgements

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