THE PRESENT-DAY TECTONIC STRESS PATTERN OF AUSTRALIA: THE NEW RELEASE OF THE AUSTRALIAN STRESS MAP PROJECT

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The Australian Stress Map (ASM) project was started in 1996 to compile a public data set for the orientation of maximum horizontal present-day tectonic stress (SHmax) in the Australian continent. The last public release of the project, by Richard Hillis and Scott Reynolds in 2003, comprised of 549 SHmax data records and successfully constrained the SHmax orientation in 16 stress provinces through Australia and Papua New Guinea. In addition, numerous geomechanical-numerical models highlighted that the stress pattern of continental Australia, at the first order, is controlled by complex plate boundary forces around the Indo-Australian Plate.

The ASM project was re-started in 2012 with a primary emphasis on compiling stress information in areas previously absent or sparsely populated by stress data. Particular focus was made to compile stress information using the recent increase in unconventional and geothermal exploration in New South Wales, Queensland, Northern Territory and South Australia. In the past four years, we extensively analysed and compiled new stress data and herein present the most up-to-date ASM database, with 2140 SHmax data records from variety of stress indicators at different depths. The new release of the ASM has 30 stress provinces that show four major SHmax orientations in the Australian continent. The SHmax orientation in northern and northwestern Australia is NNE-SSW, it rotates to a prevailing E-W orientation in southern half of Western Australia and most part of South Australia. The regional trend of the SHmax in eastern Australia is ENE-WSW which swings to NW-SE in southeastern Australia. Comparisons between the observed orientations and Australian stress models in the available literature reveal that published geomechanical-numerical models are unable to satisfactorily predict the state of stress in most of eastern Australia. In addition, we found significant localised perturbations of stress at different scales due to second and third order of stress sources. The new findings suggest that, although the plate boundary forces and gravitational potential energy have the major roles in the long wavelength stress pattern of the continent, local stress sources due to different geological structures are also significant and can lead to substantial changes in the orientation of the SHmax at the basin, field and well scale.

The new ASM database suggests a thrust faulting stress regime typically exists in the upper one km of the crust. This regime changes to a prevailing strike-slip faulting stress regime in deeper parts. A comparison between the Australian neotectonic database and the new ASM database further confirm the consistency between the SHmax orientation and the strike of neotectonic structures. However, the majority of neotectonic structures suggest a thrust faulting stress regime, which is in agreement with shallow stress information but is different with tectonic stress regime at depths of more than one km. Hence, the depth-dependency of stress regime highlights a potential pitfall of using neotectonic structures in geomechanical assessment of geo-reservoirs.

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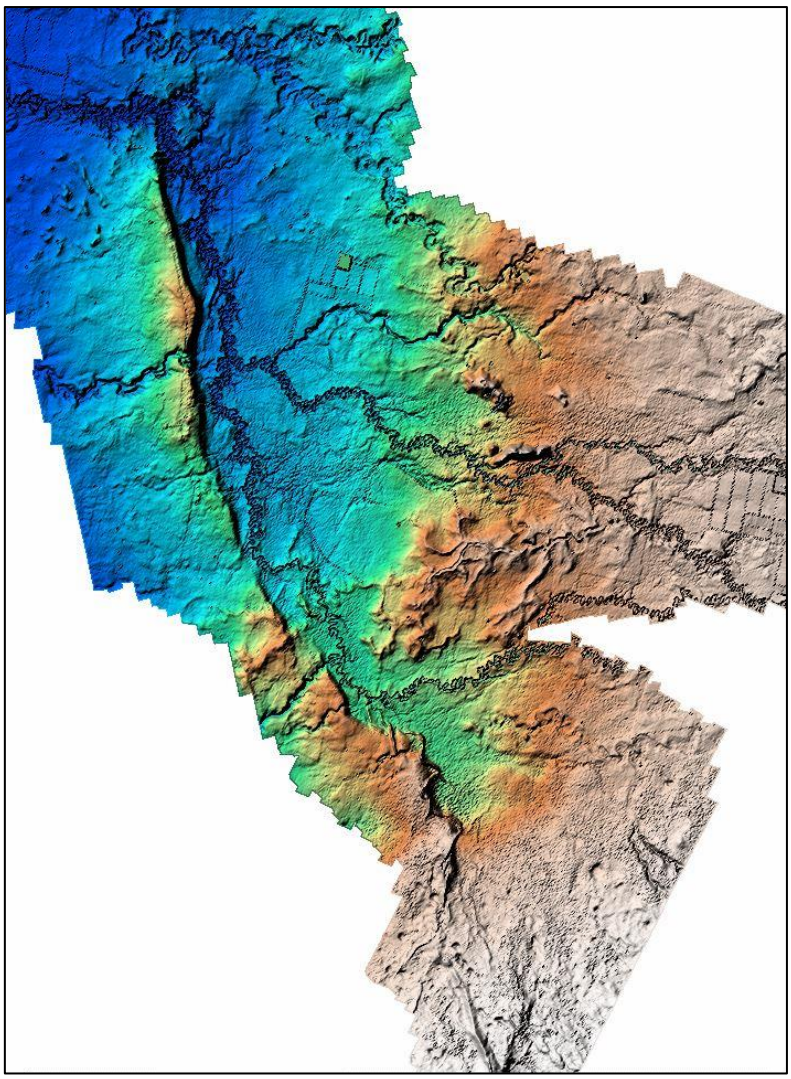

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