



## *FESAus Special Talk*

### *THE FINAL PIECE OF THE PUZZLE: 3-D INVERSION OF ULTRA-DEEP AZIMUTHAL RESISTIVITY LWD DATA – Nigel Clegg*

#### **THE FINAL PIECE OF THE PUZZLE: 3-D INVERSION OF ULTRA-DEEP AZIMUTHAL RESISTIVITY LWD DATA**

Optimal well placement requires 3-D spatial knowledge of the reservoir formation and fluids. Current 1-D inversions of ultra-deep azimuthal resistivity LWD data recover formation boundaries above and below the wellbore, which are stitched together to form pseudo-2-D models. However, 1-D modelling does not account for any lateral variations due to changes in formation dip, lithology, or fluid saturations. These lateral variations can have a significant impact on well placement and subsequent production-related decisions. An accurate and computationally efficient full 3-D inversion of ultra-deep azimuthal resistivity LWD data would yield 3-D earth models providing as-yet-unrealized insights for reservoir characterization and well placement.

The case study describes a complex reservoir with significant sub-seismic faulting and a long history of water injection. Major faults crossed the well path at an oblique angle, with zones affected by complex water flooding: resistivity boundaries indicated by 1-D inversions alone did not adequately explain the reservoir state. Fault occurrence and geometry was confirmed by density images. Several of these structures acted as a barrier to the migration of fluids and showed a sharp resistivity boundary from oil to water. Mapping of the resistivity boundaries distant from the well path was achieved using ultra-deep resistivity LWD data and validated by 4D seismic data.

The 1-D inversion assisted in well placement, however it is clear from the 3-D inversion that an azimuthal adjustment of the well path would have resulted in significantly greater reservoir exposure as a tilted oil-water contact near the heel of the well results in changes in the fluid distribution. Faults separating zones of water invasion are clearly visible, indicating the position of the oil-water contact, vital information to design completion and predict future production.

**Nigel** is the product launch champion for the Halliburton ultra-deep resistivity tool. He began working with Sperry Drilling (now Halliburton) in 1996 as an SDL field engineer in Norway, then moving on to work as a field service coordinator. Later, Nigel began working in geosteering, leading the Scandinavia geosteering team and supporting global operations. He assumed his present role in January 2017. Nigel holds an Honours BSc degree in environmental sciences with a geology major and a PhD degree in geology from the University of East Anglia (Norwich). He is a member of SPE and SPWLA.

**DATE:** Monday 30<sup>th</sup> March, 2019 - 1:00 – 2:00 PM  
**VENUE:** Remote Session ([Webinar](#))  
**COST:** As a trial run for future remote sessions, this talk will be free of charge for FESAus Members and Students/retirees. Non-members will be charged AUD\$20.  
Online registration at <https://attendee.gotowebinar.com/register/341639559092430349> .

