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Analysis of subsurface acoustic properties from geophysical logging in the Samail ophiolite

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Scientists in the Oman Drilling Project (OmanDP) acquired new dowhnole geophysical logging data in the Samail ophiolite during the 2017-2018 field seasons. These data include multichannel sonic waveforms, which allow for the estimation of acoustic velocities and other elastic parameters using automated post-processing methods. Sonic velocity logs provide one of the best means to investigate the physical properties and porosity of drilled sequences and to tie logging data with core and to other borehole measurements. Sonic waveform data were acquired using two different slim-line multichannel sonic tools in 14 separate wells within the four OmanDP target areas (i.e. BA, BT, CM, and GT sites). The tools recorded 2 to 4 waveforms over an array of receivers spanning a distance of 1-2 m from the source, an omnidirectional pressure pulse configured to generate P-wave energy over frequencies from approximately 2-30 kHz. We extract P-wave and S-wave slowness from these data using an automated semblance process within the frequency bands of highest waveform energy for each tool. For the maximum depth interval in each hole, typically from near ground level to 100-400 m depth, reliable sonic velocity logs are computed within the confidence limits of the method. Sonic velocities estimated using a conventional threshold picking procedure, where possible, tend to misrepresent the slowness when signal-to-noise is low or hole conditions change. Other processing difficulties were encountered in extracting velocities where strong effects of trapped wave modes linked to the presence of a logging tool in the borehole are occasionally encountered. In general, semblance analysis is recommended to reliably extract slowness using the maximum number of receivers available. Using the post-processed sonic log data in the future, collaborative research with OmanDP scientists will enable comparisons to acoustic data from laboratory measurements on core samples, and with other parameters derived from downhole log data, potentially allowing interpretation of the lithologic transitions, fracturing, porosity and alteration profiles as a function of depth in the Samail ophiolite.