GSA Data Repository 2019261

Wrona, T., et al., 2019, 3-D seismic images of an extensive igneous sill in the lower crust: Geology, https://doi.org/10.1130/G46150.1

Text DR1: Seismic Acquisition

The seismic data (courtesy of CGG) were acquired with a G-Gun array consisting of 3 subarrays with a source array depth of 6-9 m; a source length of 16-18 m; a shot point interval of 18.75 m; source separation of 37.5 m; a volume of 0.07456 m^3 and an air pressure of 1.379e+7 Pa. The streamer consisted of 12 up to 8 km long cables with 636 channels each; a cable separation of 75 m and group spacing of 12.5 m; depths of 7-50 m covering offsets of 150-8100 m. The data was recorded with a 2 ms sample interval; 9000 ms recording length; a low cut filter (2Hz-6db/oct) and high cut (200 Hz-370 db/oct) filter.]]

Text DR2: Seismic Processing

The seismic data were processed in 90 steps including: divergence compensation; low cut filter (1.5 Hz, 2.5 Hz); noise attenuation (e.g. swell, direct wave); spatial anti-aliasing filter (12.5 m group interval); direct wave attenuation; source de-signature; de-spike; time-variant high cut filter; receiver motion correction and de-ghosting; FK filter; cold water and tidal statics; multiple modelling with adaptive subtraction; Tau-P mute; Radon de-multiple; far angle destriping; multiple attenuation; binning (75 m interval, 107 offset planes); acquisition hole infill; 5-D regularization; 3-D true amplitude Kirchhoff pre-stack time migration; residual move-out correction; Linear FL Radon; full offset stack with time-variant inner and out mute; acquisition footprint removal; crossline K filter; residual de-striping and dynamic Q-compensation. The seismic volume was zero phase processed with SEG normal polarity.

Text DR3: Lower Crustal Velocities

Christiansson et al. (2000) show 1-D velocity-depth functions derived from two-ship seismic refraction data at two locations (ESP 50, ESP 51) with different methods (slope-intercept, Herglotz-Wiecherts, t2-x2, Tau-p, forward model). At ESP 50, the slope intercept and Tau-p method indicate lower crustal velocities of 8 km/s. At ESP 51, the slope intercept, t2-x2 and forward model suggest lower crustal velocities of 8 km/s. All other methods provide no velocity estimate for the lower crust. Odinsen et al. (2000) and Fichler et al. (2011) do not derive new velocity-depth data. Rosso (2007) derives new 2-D velocity-depth data by combining reflection and refraction data recorded along two transects (8 OBS and 8 REFTEK receivers) with Transect 1 (NSDP84-1) passing the two locations (ESP 50, ESP 51) analyzed by Christiansson et al. (2000). Based on a comprehensive analysis including event picking, ray-tracing and uncertainty estimation for the entire dataset, Rosso (2007) concluded that the lower crust has velocities of 6.9±0.1 km/s.

Text DR4: Tuning Thickness

While we have already estimated the tuning thickness (180±40 m) from the seismic velocity (6.9±0.1 km/s) and dominant frequency (10±2 Hz) of the interval of interest as a quarter of the wavelength ($\lambda/4=v/f/4$), we validate this value with a second estimate based on the amplitude versus thickness cross-plot (Fig. 2D). This estimate is based on the effect that an amplitude maximum occurs at the point of maximum constructive interference between the top and base reflection, i.e. the tuning thickness (Connolly, 2005; Francis, 2015). For this estimate, we first extract the amplitude of the top of the LCR and then calculate the thickness by multiplying the time difference between top and base of the LCR with the seismic velocity (6.9±0.1 km/s; Rosso, 2007). Cross-plotting the amplitude versus thickness reveals a maximum at a thickness of ~180 m indicating that this tuning thickness estimate is consistent with the standard estimate based on a quarter of the wavelength (Brown, 2011).

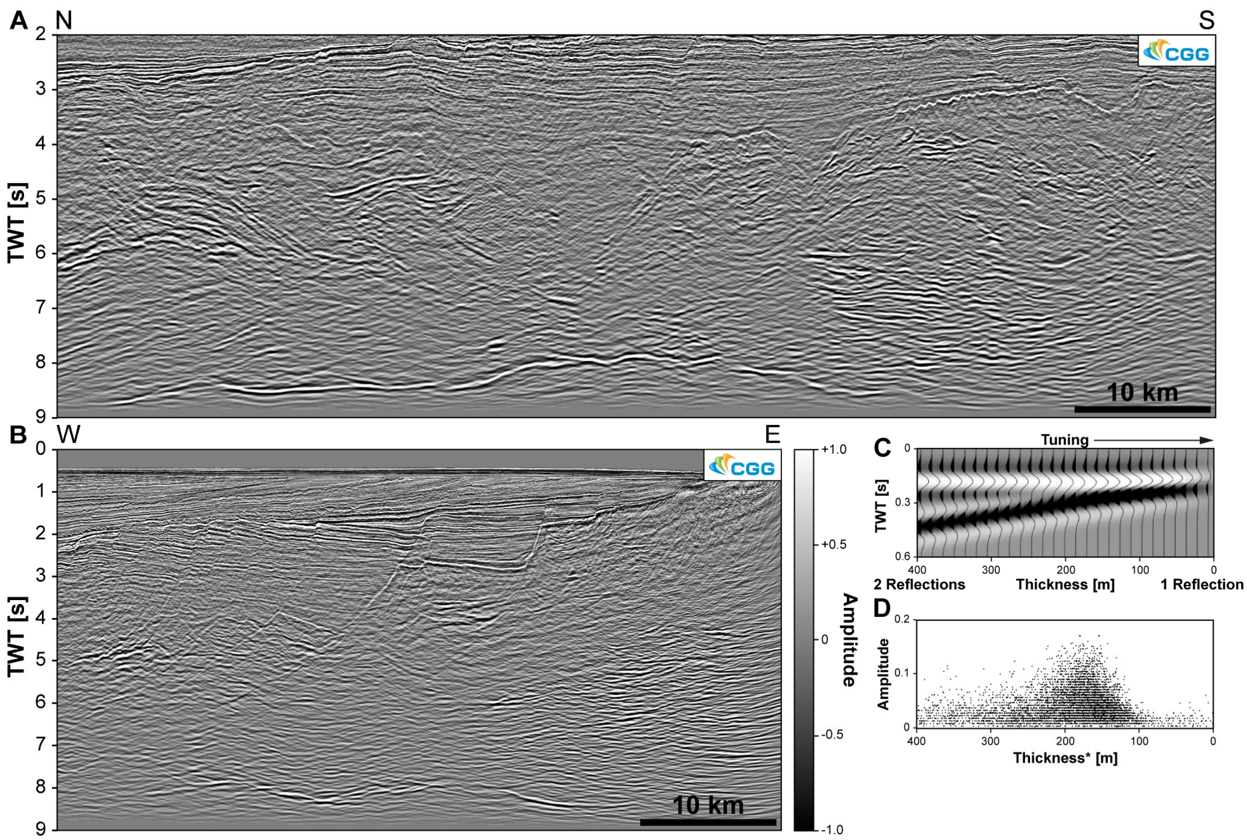

Figure DR1. Uninterpreted version of Figure 2.

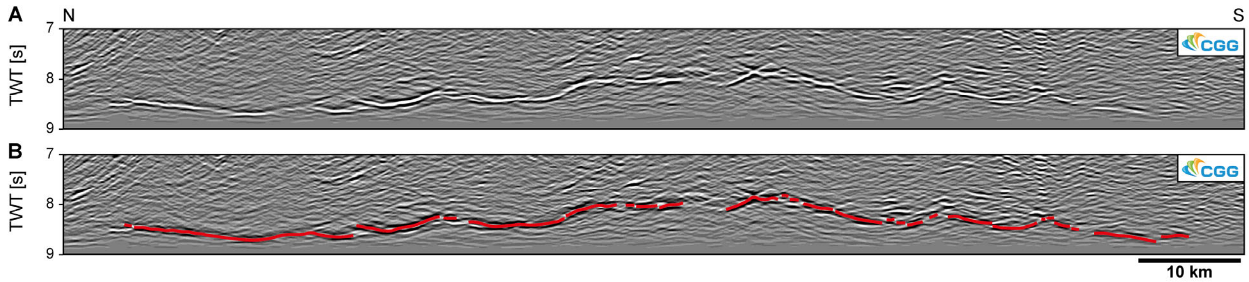

Figure DR2. Uninterpreted and interpreted seismic section of Figure 3E.

Animation DR1. Three-dimensional animation of lower crustal intrusion.