Supporting Information for

"Hot upper mantle beneath the Tristan da Cunha Hotspot, from probabilistic Rayleigh-wave inversion and petrological modeling"

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Caption S1.

Tomographic phase velocity maps at 4 periods. The maps in each row are for the same periods, with the frames on the right showing the inter-station path coverage at the period. Triangles show the seismic stations, the star indicates the Tristan da Cunha Island. The reference phase velocity at each period is given below the period value, top right of the frames on the left. The minimum and maximum deviations from the reference across the map are given at bottom left, in m/s and in per cent. The color scale used for all the maps is plotted at the bottom. The maps were computed with 15% of outlier interstation measurements removed, so as to constrain the models only with the most mutually consistent data [e.g., *Deschamps et al.*, 2008; *Endrun et al.*, 2011; *Polat et al.*, 2012]. Nevertheless, errors in the remaining data are still relatively large, whereas the lateral heterogeneity across the area is weak, as evidenced by the phase-velocity maps. Because of this, the inversions yield relatively low

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variance reductions (e.g., 28% at 13 s; 36% at 21 s; 26% at 30 s; 26% at 40 s). In order to reduce the effect of noise on interpretation, we try out an approach of "stacking" phase-velocity maps in ranges of periods (Figure S2).

Caption S2.

"Stacks" of phase-velocity maps. Phase-velocity maps were computed at a 1-s interval within the period ranges indicated and then averaged, so as to reduce random errors in the maps. The resulting "stacks" show the same large-scale features as original, periods-specific ones but with the small-scale noise removed, to a large extent. The maps at shorter periods (11–15 s) are sensitive to the oceanic crust and uppermost mantle. We observe a lower velocities in the NE compared to the SW part of the region. This can be attributed to the greater water depth in the NE (Figure 4a, 4b) (Rayleigh waves, especially at shorter periods, are influenced by the 3–4 km thick water layer). In contrast, low velocities in a ~1-km wide area beneath and around the active volcanic island are probably mostly due to the thicker crust there; relatively low seismic velocities in the crust and uppermost mantle may also play a role. At periods of 16–25 s, Rayleigh waves are mostly sensitive to the lithospheric mantle (~15–50 km depths). Relatively low velocities are now seen in the SW part of the region. This pattern, with the relatively low phase velocities to the south and southwest of Tristan da Cunha, persists at the longer periods as well. This suggests that the entire mantle lithosphere S-SW of TdC is warmer than N-NE from it. The phase-velocity contrast between the two domains is 1.0–1.5%, decreasing with period. The difference can probably be explained primarily by the lithosphere to the south and southwest of Tristan being younger than to the north and northwest of it (Figure 4b).

References

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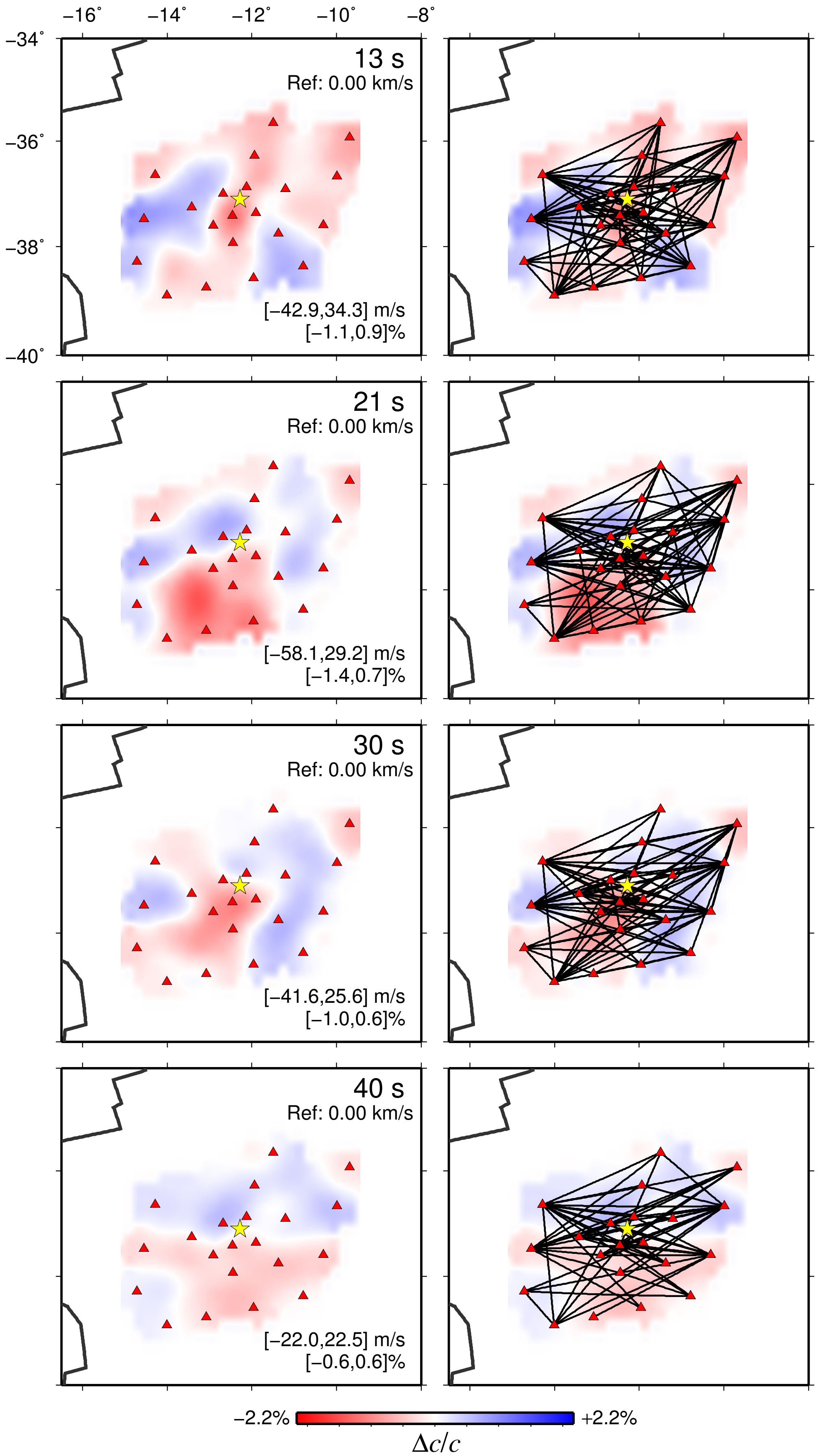
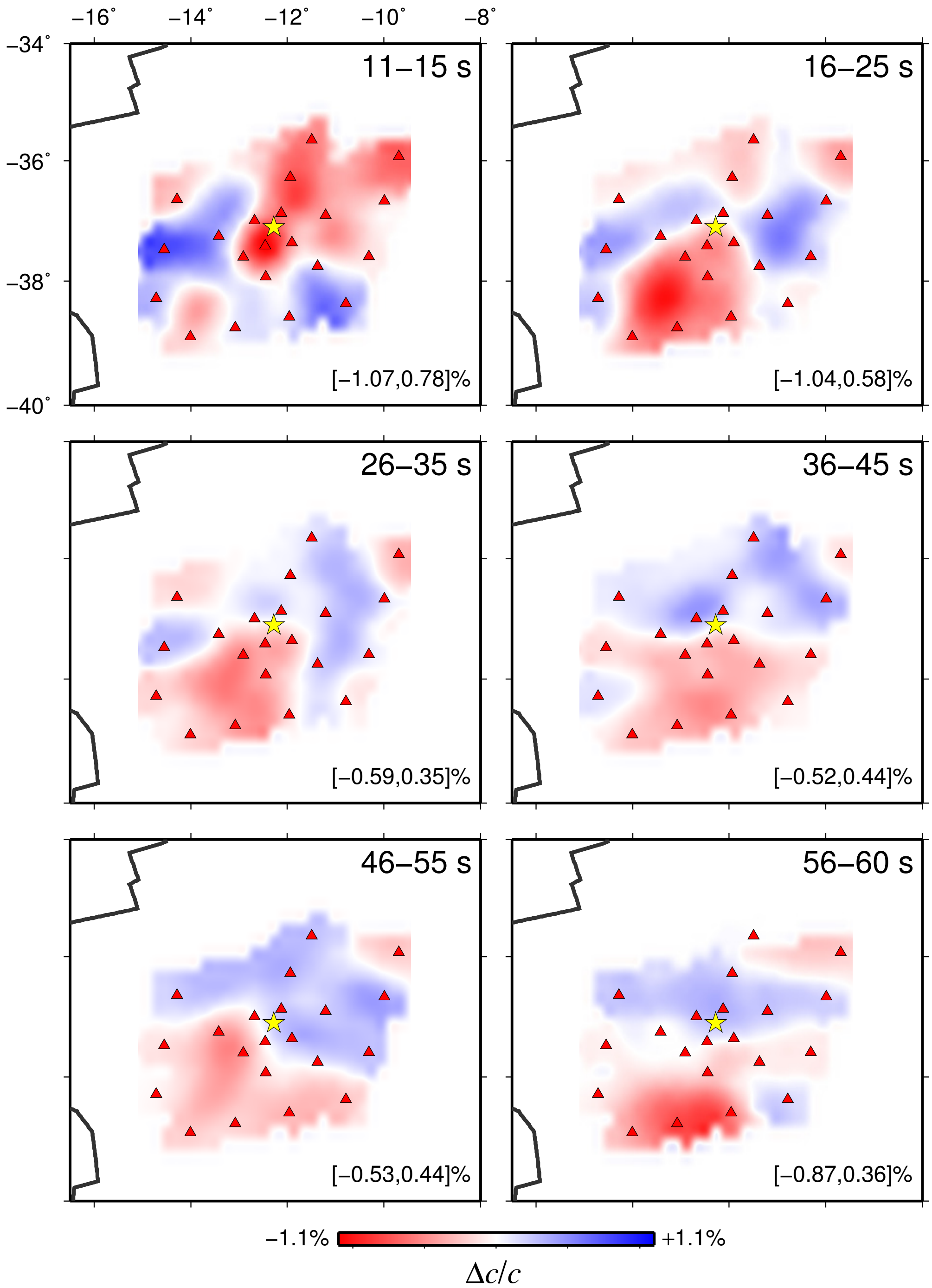
Polat, G., S. Lebedev, P. W. Readman, B. M. O'Reilly, and F. Hauser (2012), Anisotropic Rayleigh-wave tomography of Ireland's crust: Implications for crustal accretion and evolution within the Caledonian Orogen, *Geophysical Research Letters*, *39 (L04302)*, doi: 10.1029/2012GL051014.



−16˚
−14˚
−12˚
−10˚
−8˚
−34˚
−36˚
−38˚
−40˚
13 s
Ref: 0.00 km/s
[−42.9,34.3] m/s
[−1.1,0.9]%
21 s
Ref: 0.00 km/s
[−58.1,29.2] m/s
[−1.4,0.7]%
30 s
Ref: 0.00 km/s
[−41.6,25.6] m/s
[−1.0,0.6]%
40 s
Ref: 0.00 km/s
[−22.0,22.5] m/s
[−0.6,0.6]%
−2.2%
+2.2%
Δc/c


−16˚
−14˚
−12˚
−10˚
−8˚
−34˚
−36˚
−38˚
−40˚
11–15 s
[−1.07,0.78]%
16–25 s
[−1.04,0.58]%
26–35 s
[−0.59,0.35]%
36–45 s
[−0.52,0.44]%
46–55 s
[−0.53,0.44]%
56–60 s
[−0.87,0.36]%
−1.1%
+1.1%
Δc/c