

Supplementary Fig. 4. Westward drift of the Americas through mantle flow against Precambrian keels.

(a) Westward drift of the Americas in a hotspot reference frame superposed

on topography (yellow arrows from 28 Husson et al., 2012; white from 27 Gripp and Gordon,

2002). Note that, apart from in the SW of the map area, plate motion is oblique to spreading

ridges and transform faults. (b) Offset of related areas of positive and negative divergence at the

base of the mantle lithosphere from the mid-Atlantic ridge and subduction beneath South

America (Husson et al. 2012) consistent with westward displacement of the North and

South American plates since initiation of these plate-bounding structures. (Raw data from which

the +0.15 and -0.15 contours of divergence were plotted was provided by L. Husson.) (c)

Interpreted hotspots (data from D. Mueller, Earthbyte, University of Sydney). (d) Changes in age

of Pacific seamounts reflecting relative motions of plates with respect to fixed hotspots. (Data

from Clouard and Bonneville, 2004). E = Easter, J = Juan Fernandez, S = Sandwich, and JF =

Juan de Fuaca.

(e) Next page (see notes below if no image). 3D pdf of 5% & 6% dVs isosurfaces (i.e. differences in S-wave velocity from the Preliminary Reference Earth Model of Dziewonski and Anderson, 1981) calculated from S-wave tomographic data presented by Godey et al. (2003). Isosurfaces illustrate the presence of deep keels of Archaean mantle extending beneath the entire North American plate. Mantle flow pushing on these keels is interpreted as driving the western motion of the North American plate. Topographic image is from USGS Shuttle Radar Topography Mission data. Note that tomographic data covers only North America and the Caribbean (i.e. no data is presented for Greenland). 3 x vertical exaggeration.

This is an interactive image: click on image to rotate. *Right-clicking on the topography layer will control transparency; useful in aerial views (layers can be selected in 3D Model Tree in the view pane).*

Sections through the model and changes in lighting etc. may be made using tools on the 3D toolbar.

Note that:

- 3D interactive capabilities require Adobe Acrobat™ or Acrobat Reader™ (3D images will not display in Preview or PDFpenPro Mac software).

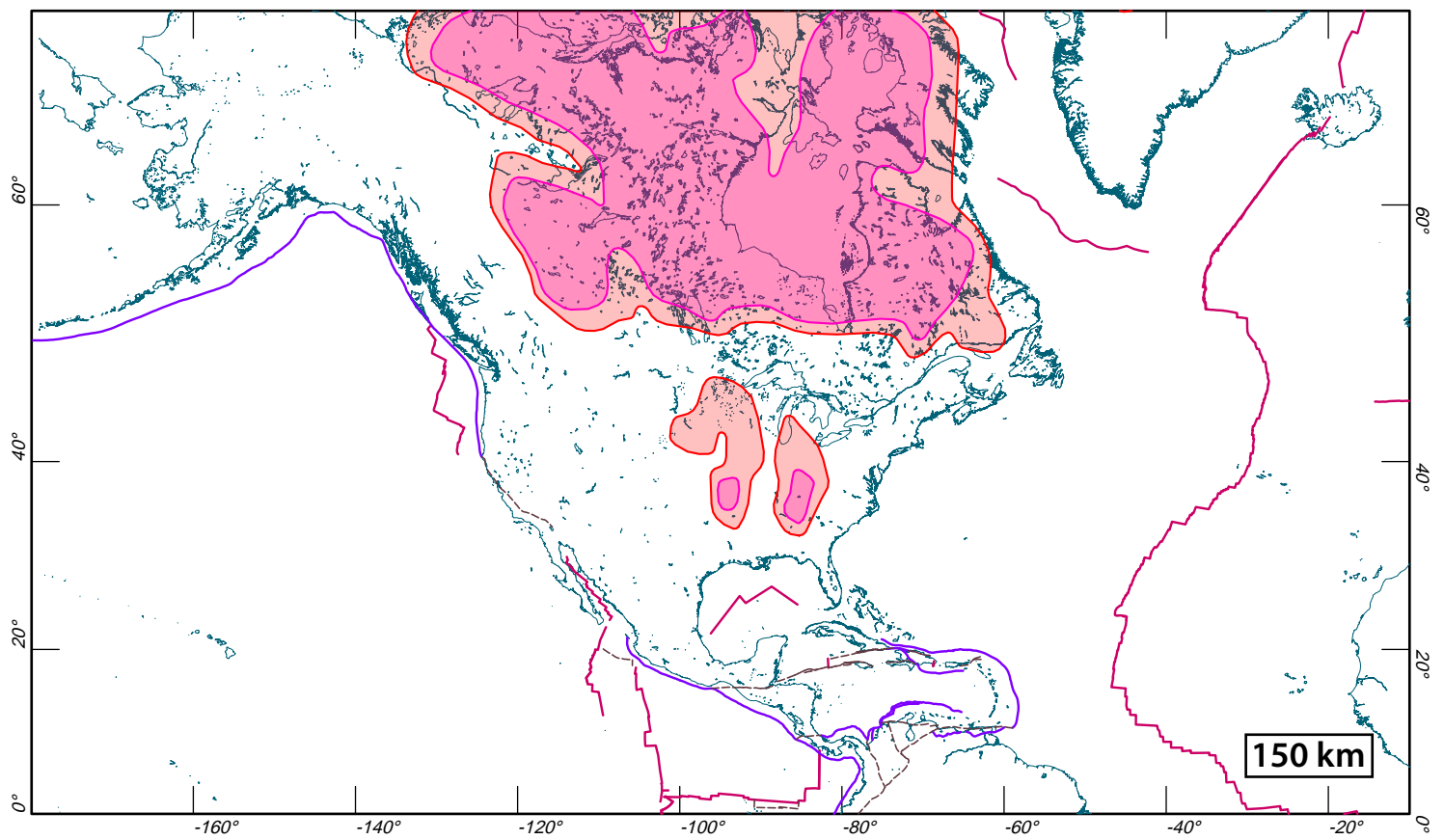
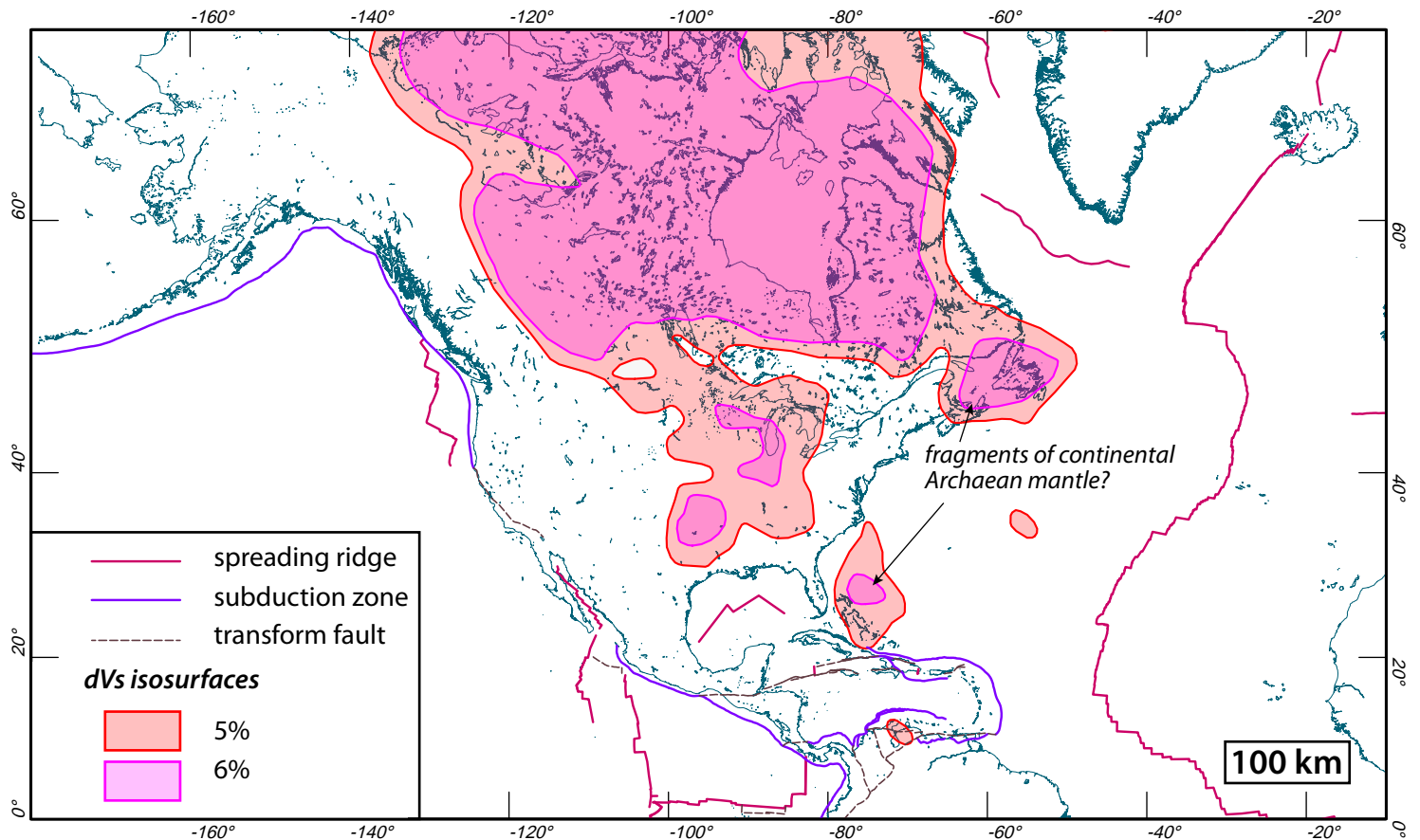
- it may be necessary to accept to 'trust this document' if prompted when the page is opened

- the page may first display as blank or black; if no image is displayed, click on the page after having accepted to trust this document.

(f) 3D pdf illustrating isosurfaces (as in Supplementary Fig. 2) and slices

through the 3D S-wave tomographic model using data presented by Godey et al. (2003).

This is an interactive image: click on image to rotate. Select and deselect layers to show different slices; some slices can be combined to show 'cut-outs' along two axes. Right-clicking on the topography layer will enable it to be made transparent.



(g) Map view of 5% and 6% dVs contours (see caption to e) at 100 and 150 km depth. Areas of interpreted Archaean sub-crustal lithospheric mantle (SCLM) extend beyond the Superior and Minnesota River Valley Archaean cratons beneath continental crust of central USA and Newfoundland. A fragment of Archaean SCLM beneath oceanic crust (at the margin with continental crust) is suggested East of Florida (similar to documented fragments of continental SCLM in oceanic lithosphere off Africa documented by Begg et al, 2009). A continuous 'wall' of deep and strong Archaean mantle thus extends from south to north beneath the entire North American plate.

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- CLOUARD, V. & BONNEVILLE, A. 2004. Ages of seamounts, islands and plateaus on the Pacific plate. <http://www.mantleplumes.org/PacificAges.html>.
- DZIEWONSKI, A.M. & ANDERSON, D.L. 1981. Preliminary reference Earth model. *Physics of the Earth and Planetary Interiors*, **25**, 297-356.
- GODEY, S., SNIEDER, R., VILLASENOR, A. & BENZ, H. 2003. Surface wave tomography of North America and the Caribbean using global and regional broadband networks: phase velocity maps and limitations of ray theory. *Geophysical Journal International*, **152**, 620-632.
- HUSSON, L. 2012. The dynamics of plate boundaries over a convecting mantle. *Physics of the Earth and Planetary Interiors*, **212-213**, 32-43