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Supplementary information

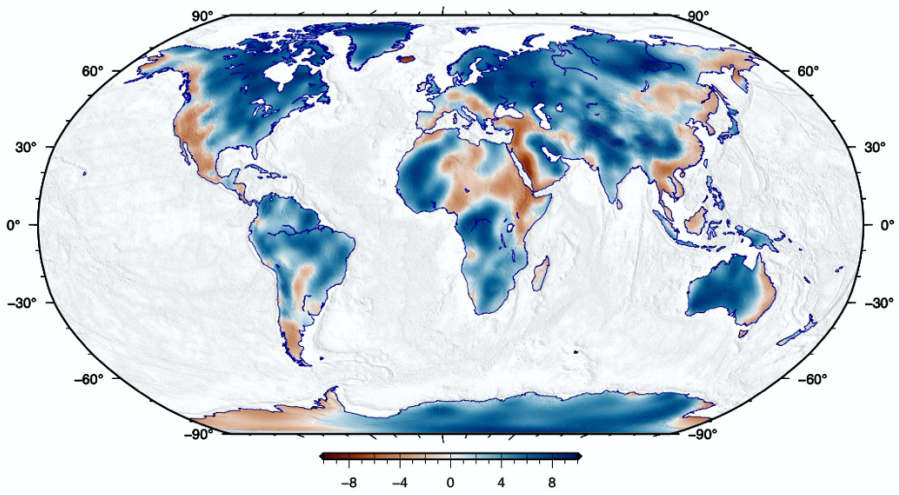
Deep continental roots and cratons

In the format provided by the authors and unedited

SUPLLEMENTARY NOTES

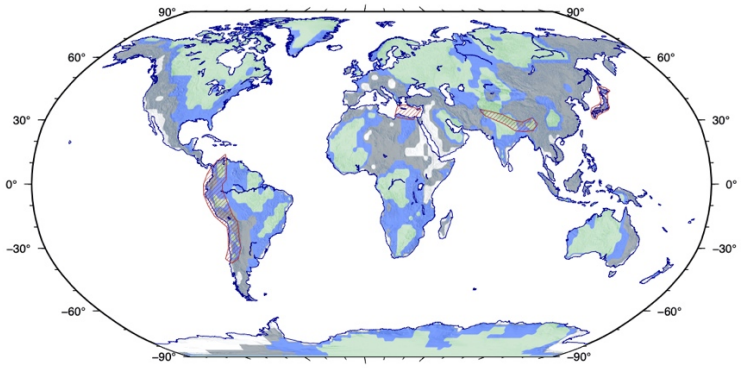
Supplementary Figure 1a: Seismic imaging of continental mantle.

Global S-wave tomographic slice (oceans excluded) through the Earth at 150 km depth. The scale bar displays % Vs anomalies relative to a modified AK135 reference model [References 23 and 24 of the main manuscript]. Colour scale is the "Vik" scheme derived using the recommendations for colour scales on maps [Reference 166 of the main manuscript].



Supplementary Figure 1b : Seismic tectonic regionalisation of lithosphere.

Tectonic regionalisation [using the method of reference 23 – Main Manuscript] of the seismic data to objectively classify seismic velocities into regions of similarity within the Earth's upper mantle; falling out naturally from this is the division of continents from oceans (not shown), and the subdivision of continents into cratonic very deep lithosphere (green) that broadly coincides with the Archean crustal nuclei to cratons, cratonic deep lithosphere (150 km thick or more – blue colour), broadly coinciding with the Super-cratons and Composite cratons defined in Fig. 1 of the main manuscript, and non-cratonic mantle underpinned by lithospheric mantle extending to <150km to the lithosphere-asthenosphere boundary (grey shading). Diagonal stripes cover regions with apparent thick lithosphere that are strongly influenced by subducting slabs and are not classified as cratons. The boundaries of the ***cratons as a whole***, as defined as the edges of the blue shaded regions, underpinned by lithosphere > 150km thick, ***comprise 63% of the total continental landmass***. ***Cratonic nuclei*** with the deepest lithospheres, from this classification occupy ***~ 34% of the total continental landmass***.



Box 3a: Locations grouped by type of craton in Re-Os model age compilation

Names are either the name of a given mine, or the location of the host kimberlite, lamproite or basalt

Archean Cratonic Mantle:

Kalahari craton Archean nuclei – Letseng Mine, Lhiqhobong Mine, Matsoku, Mothae Mine, Thaba Putsoa, Newlands Mine, Monastery Mine, Kimberley Mines (Bultfontein), Jagersfontein Mine, Finsch Mine, Murowa Mine.
Karelian craton – Kaavi, Kaavi-Kupio
Rae craton – Somerset Island, Repulse Bay, Pelly Bay, Darby
Slave craton – Jericho Mine, Diavik Mine, Ekati Mine, Artemisia, Gahcho Kué
North Atlantic Craton – Chidliak Mine (Baffin Island), Safartoq (W. Greenland), Nigerlikasik and Pyramidefjeld (W. Greenland)
Superior craton – Attawapiskat
Eastern North China craton – Fuxian, Mengyin (Pre-lithosphere thinning kimberlites).
Wyoming craton – Eagle buttes, Williams
Sask craton – Fort a la Corne

Proterozoic Cratonic Mantle

Kalahari composite craton – Venetia Mine, Orapa Mine, Lethlakane, Namaqua-Natal terrane kimberlites (Ramatseliso, East Griqualand, Abbotsford, Melton Wold, Uintjiesberg, Markt, Hebron, Hoedkop, Gansfontein, Klipfontein), Rehoboth terrane kimberlites (Gibeon field)
Congo composite craton – Usagaran terrane (Labait, Tanzania)
Western Australian composite craton – Argyle Mine
Laurentia Super-craton – Mackenzie craton (Parry Peninsula), Victoria Island; Hearne Terrane (Buffalo Head Hills), Central Plains Orogen (Sloan)
South American Super-craton - Alto Paranaiba
Siberian composite craton – Udachnaya Mine, Obnazhennaya

Modified Cratonic Mantle

South East Siberia – Tok
East China craton – Longquanlongwan, Kuandian, Hanuoba, Qixia, Yangyuan, Jining, Datong, Fansi, Fushan, Hebi, Dalongwan, Penglai, Shanwang, Baekryeong Island, Jeju Island, Pyeongtaek
Colorado Plateau - Big Creek
Mojavia – Cima
West Greenland – Ubekent Ejland
East Greenland - Wiedemann Fjord

Phanerozoic Oceanic Mantle (Abyssal, Arcs, Ophiolites)

Abyssal – Mid Atlantic Ridge Hole 1274A (ODP Leg 209), Kane Fracture Zone, SW Indian and American-Antarctic Ridges, MAR 15 20 FZ Cruise: Academic Boris Petrov, SWIR Atlantic II FZ Cruise: Robert Conrad 27-9, SWIR Du Toit FZ Cruise: Protea 5, Gakkel ridge (Arctic Ocean), Lena Trough, Arctic basin, Mid Atlantic Ridge (MAR) Saint Paul Fracture Zone
Ophiolites – Tiebaghi massif, New Caledonia; Ouassë Bay, New Caledonia; Me Maoya massif, New Caledonia; Massif du Sud, New Caledonia; Poum, New Caledonia; Babouillat, New Caledonia; Poum, New Caledonia; Babouillat, New Caledonia; Kopeto, New Caledonia; Mamonia complex, Cyprus, Troodos, Cyprus; Oman Ophiolite, Shetland Ophiolite, Taitao ophiolite; southern Chile, Koycegiz,

Turkey; Tekirova, Turkey, Marmaris, Turkey; Macquarie Island, Australia, Ligurian ophiolites, Italy; Totalp, Austria; Purang ophiolite, southwestern Tibet; Central Tibet - Bangong-Nuijang suture zone; Yarlung-Zangbo ophiolite, Tibet;
Arcs – Kamchatka (Bakening, Avachinsky, Valovayam; Cascade arc (Simcoe); Japan arc (Ichinomegata); SW Japan (Kurose); Bismark Archipelago (PNG); Izu-Bonin-Mariana Forearc, Conical seamount.

Box 3b: Locations plotted on Age versus olivine composition plot

1) Siberia (Udachnaya, Archean samples, plus Obnazhennaya)
2) Argyle, Australia
3) Kalahari craton - Kaapvaal nucleus (excluding Kimberley & Premier)
4) Tanzania craton
5) Kalahari Craton - Kaapvaal nucleus (Kimberley)
6) Wyoming craton
7) North Atlantic Craton (E, W. and SW Greenland)
8) Slave craton
9) Congo craton
10) Kalahari Craton - Zimbabwe nucleus (Murowa-Sese)
11) North China craton (Archean samples)
12) Rae craton - Somerset Island
13) Kalahari craton - East Griqualand
14) Kalahari craton - Namaqualand
15) Kalahari craton - Namibia
16) Kalahari Craton - Kaapvaal nucleus (Premier)
17) Siberia (Udachnaya, Proterozoic samples)
18) Pyrenees orogenic massifs
19) Parry Peninsula & Victoria Island
20) North China Craton (Post-Archean samples)
21) Ronda Massif, Spain
22) China - Songshugou
23) San Carlos - USA
24) Bay of Islands Ophiolite
25) Iwanadake ophiolite, Japan
26) Dun Mountain ophiolite, New Zealand
27) Ontong Java Plateau, Pacific Ocea
28) Anita peridotite, New Zealand
29) Mariana Arc, Pacific Ocean
30) Kamchatka, Russia
31) South Sandwich Islands, S. Atlantic Ocean
32) Lihir Island, Papua New Guinea
33) Japan arc-related mantle xenoliths - various locations