**Supporting Table 1 Summary of seismic profiles used in this study**

| Region | Years of acquisition | Length of profile (km) | Maximal depth (km) | Shots | length of PmP (km) | Reference |
|---|---|---|---|---|---|---|
| Stage I (Paleoproterozoic) | | | | | | |
| Capricorn | 1979 | 700 | Moho | 8 | >500 | Drummond, 1981; 1988 |
| Fennoscandia | 2017 | 550 | Moho | 7 | 320 | Buntin et al., 2021 |
| | 1982 | 430 | Moho | 7 | 400 | Luosto et al., 1990 |
| Torngat | 1990 | 432 | Moho | 6 | 300 | Funck and Louden, 1999 |
| Trans-Hudson | 1993 | 750 | Moho | 39 | 600 | Németh et al., 2005 |
| | | 500 | Moho | | 400 | |
| | | 750 | Moho | | 600 | |
| Wopmay | 1997 | 720 | Moho | 11 | 500 | Fernández Viejo and Clowes, 2003 |
| Akitkan | | 1000 | Moho | | 900 | Solovyev et al.,<br>Suvorov et al., 2023 |
| Stage II (Neoproterozoic) | | | | | | |
| Grenville | 1988 | 260 | Moho | 7 | 200 | Zelt and Forsyth, 1994 |
| | 1992 | 620 | Moho | 22 | 500 | Winardhi and Mereu, 1997 |
| | 1996 | 322 | Moho | 6 | 240 | Funck et al., 2001 |
| | | 304 | Moho | | 250 | |
| | 1988 | 650 | Moho | 32 | 550 | Musacchio et al., 1997<br>Hughes and Luetgert, 1991 |
| Sveconorwegian | 1984 | 2100 (5 profiles in total) | Moho | 20 | >1500 | EUGENO-S working group, 1988 |
| | 2007 | 300~400 (3 profiles) | Moho | 26 | 250~300 | Stratford and Thybo, 2011 |
| Tocantins | 1997 | ~ 300 (3 profiles) | Moho | 11 | ~200 | Berrocal et al., 2004 |
| | | 530 | Moho | 14 | 450 | Soares et al., 2006 |
| | 2013 | 700 | Moho | 15 | 600 | Bernardes et al., 2023 |
| Arabian | 1974 | 1000 | Moho | 6 | 600 | Mooney et al., 1985<br>Stern and Johnson, 2021 |
| Stage III (Early Paleozoic) | | | | | | |
| Timanide | | 2400 | | | >2000 | Ivanova et al., 2011 |
| Lachlan | 1997 | 364 | Moho | 6 | 300 | Finlayson et al., 2002 |
| Appalachian | 1988 | 650 | Moho | 32 | 550 | Musacchio et al., 1997<br>Hughes and Luetgert, 1991<br>Hughes et al., 1994 |
| Caledonian | 1982-1995 | 200~350 (11 profiles) | Moho | | 150~250 | Landes et al., 2005 |
| | 1990-1994 | 250~350 (6 profiles) | Moho | Airguns | 150~250 | Schmidt-Aursch and Jokat, 2005<br>Mandler and Jokat, 1998<br>Schlindwei and Jokat, 1999 |
| | 2007 | 300~400 (3 profiles) | Moho | 26 | 250~300 | Stratford and Thybo, 2011 |
| Kunlun | 2014 | 750 | Moho | 11 | 650 | Jia et al., 2019 |
| | 2010 | 1000 | Moho | 9 | 900 | Teng et al., 2014 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2009 | 430 | Moho | 11 | 300 | Zhang et al., 2013a |
| Tienshan | 1997 | 1200 | Moho | 12 | 600 | Li et al., 2001 |
| Altia | 2018 | 637 | Moho | 10 | 550 | Bai et al., 2023 |
| Cathasia | 1993 | 380 | Moho | 5 | 300 | Zhang et al., 2005 |
| | 1989 | 400 | Moho | 6 | 300 | Zhang et al., 2013b |
| Ribeira | 2013 | 700 | Moho | 15 | 600 | Bernardes et al., 2023 |
| Stage IV (Late Paleozoic - Mesozoic) | | | | | | |
| Urals | 1995 | 340 | Moho | 14 | 240 | Carbonell et al., 1996<br>Carbonell et al., 2000 |
| | | 1000 | > 200 km | Nuclear | >800 | Druzhimin et al., 1997 |
| Dabie | 1994 | 420 | Moho | 8 | 350 | Bai et al., 2007<br>Dong et a., 1998 |
| | 2001 | ~200 (6 profiles) | Moho | 4 | 150 | Liu et al., 2003 |
| Mongol-Okhotsk | 2014-2015 | 1100 | | 37 | 900 | Solovyev et al., 2020 |
| New England | 1984 | 300 | Moho | 5 | 240 | Finlayson and Collins, 1993 |
| | 1986 | 550 | Moho | 9 | 450 | Aichroth et al., 1992 |
| Vasican | 1996 | 200 | Moho | 34 | 150 | Landes et al., 2005 |
| | 1989 | ~500 (6 profiles) | ~100 km | 15 | 300 | ILIHA DSS Group, 1993 |
| Stage V (Cenozoic) | | | | | | |
| | 1997 | 560 | Moho | 9 | 440 | Pedreira et al., 2003 |
| | 2010 | 550 | Moho | 6 | 300 | Ayarza et al., 2014 |
| | 1987 | ~600 | Moho | 5 | 500 | Ye et al., 1995 |
| Alpine | 1975~1978 | 250~450 (6 profiles) | Moho | 13 | 200~400 | Scarascia and Cassinis, 1997 |
| | 2002 | 633 | Moho | 20 | 500 | Brückl et al., 2007 |
| | 2002 | 533 | Moho | | 400 | |
| | 1997 | 535 | Moho | 10 | 450 | Clowes et al., 2005<br>Hammer and Clowes, 2004 |
| Cordillera | 1989 | 450 | Moho | 10 | 350 | Spence and Mclean, 1998 |
| | 1997 | 460 | Moho | 8 | 400 | Welford et al., 2001 |
| | 1994 | 180 | Moho | 4 | 120 | Morozov et al., 1998 |
| Kolyma | | 600 | Moho | 8 | > 500 | Suvorov and Melnik, 2021 |
| Lhasa, Tibet | 2015 | 450 | Moho | 10 | 250 | Wang et al., 2021 |
| Low quitly profiles | | | | | | |
| Anatolian | 2010 | 650 | ~25 km | 2 | 0 | Feld et al., 2017 |
| Pamir | 2008 | 400 | ~40 km (< Moho) | earthquakes | 0 | Mechie et al., 2012 |
| | 1962~1967 | < 300 km | ~40 km (< Moho) | 17 | 0 | Wigger et al., 1991 |
| Andes | 1994 | 500 | ~50 km (< Moho) | 13 | 0 | Schmitz et al., 1999 |
| | 2000 | 360 | ~50 km (< Moho) | earthquakes | 0 | Bohm et al., 2002 |

**Supporting Table 2 Statistical properties of the orogens crustal structure**

| region | No. | Age (Ma) | Region | Moho Depth (km) Mean | Moho Depth (km) S.D. | Bulk crust average: Density (g/cm$^3$) Mean | Density S.D. | Bulk crust average: Vp(km/s) Mean | Vp S.D. | Thickness (km): Upper crust Mean | Upper crust S.D. | Thickness (km): Middle crust Mean | Middle crust S.D. | Thickness (km): Lower crust Mean | Lower crust S.D. | Precentage: Upper crust Mean | Upper crust S.D. | Precentage: Middle crust Mean | Middle crust S.D. | Precentage: Lower crust Mean | Lower crust S.D. | No. of data points | Reference of seismic profiles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage I (Paleoproterozoic) | | | | | | | | | | | | | | | | | | | | | | | |
| Capricorn | 1 | 2000-1900 | AU | 54.5 | 0.2 | 2.87 | 0.00 | 6.61 | 0.00 | 9.1 | 0.1 | 22.5 | 0.2 | 22.9 | 0.2 | 17 | 0 | 41 | 0 | 42 | 0 | 15 | Drummond, 1981 |
| Fennoscandia | 2 | 2100-1800 | EU | 50.1 | 7.2 | 2.87 | 0.02 | 6.62 | 0.07 | 17.4 | 2.1 | 15.2 | 3.8 | 17.6 | 5.3 | 36 | 7 | 30 | 5 | 34 | 6 | 72 | Buntin et al., 2021<br>Luosto et al., 1990 |
| Torngat | 3 | 1900-1800 | NA | 39.2 | 4.4 | 2.85 | 0.01 | 6.54 | 0.03 | 13.7 | 1.8 | 14.6 | 3.5 | 10.9 | 2.7 | 35 | 6 | 37 | 8 | 28 | 4 | 31 | Funck and Louden, 1999 |
| Trans-Hudson | 4 | 1900-1800 | NA | 45.6 | 4.1 | 2.86 | 0.01 | 6.58 | 0.04 | 14.2 | 2.1 | 18.9 | 4.0 | 12.4 | 5.4 | 32 | 6 | 42 | 10 | 27 | 9 | 96 | Németh et al., 2005 |
| Wopmay | 5 | 1900-1800 | NA | 34.1 | 0.5 | 2.85 | 0.01 | 6.52 | 0.04 | 15.6 | 0.4 | 8.0 | 2.4 | 10.4 | 2.9 | 46 | 2 | 24 | 7 | 31 | 8 | 10 | Fernández Viejo and Clowes, 2003 |
| Akitkan | 6 | 1900-1800 | AS | 47.9 | 0.8 | 2.85 | 0.01 | 6.54 | 0.03 | 16.0 | 1.6 | 14.7 | 3.2 | 17.1 | 3.4 | 33 | 4 | 31 | 7 | 36 | 7 | 46 | Kashubin et al., 2021 |
| *Ranges* | | | | *34.1~54.5* | | *2.85~2.87* | | *6.52~6.62* | | *9.1~17.4* | | *8.0~22.5* | | *10.4~22.9* | | *17~46* | | *24~41* | | *27~42* | | | |
| Stage II (Neoproterozoic) | | | | | | | | | | | | | | | | | | | | | | | |
| Grenville | 1 | 1400-900 | NA | 43.2 | 2.3 | 2.88 | 0.01 | 6.66 | 0.05 | 9.7 | 2.6 | 16.0 | 2.3 | 17.5 | 3.6 | 23 | 7 | 37 | 5 | 40 | 9 | 130 | Zelt and Forsyth, 1994<br>Winardhi and Mereu, 1997<br>Funck et al., 2001<br>Musacchio et al., 1997 |
| Sveconorwegian | 2 | 1400-900 | EU | 39.3 | 3.1 | 2.85 | 0.01 | 6.53 | 0.03 | 15.5 | 2.0 | 13.5 | 1.8 | 10.3 | 2.8 | 40 | 6 | 35 | 5 | 26 | 5 | 57 | EUGENO-S working group, 1988<br>Stratford and Thybo, 2011a |
| Tocantins | 3 | 1000-600 | SA | 38.9 | 2.5 | 2.85 | 0.00 | 6.54 | 0.01 | 13.5 | 1.0 | 12.1 | 2.8 | 13.3 | 1.2 | 35 | 2 | 31 | 6 | 34 | 4 | 27 | Berrocal et al., 2004<br>Soares et al., 2006<br>Bernardes et al., 2023 |
| Arabian | 4 | 850-600 | AF | 41.5 | 0.0 | 2.84 | 0.00 | 6.49 | 0.00 | 21.5 | 0.0 | 8.9 | 0.0 | 11.2 | 0.0 | 52 | 0 | 21 | 0 | 27 | 0 | 24 | Stern and Johnson, 2021 |
| *Ranges* | | | | *38.9~43.2* | | *2.84~2.88* | | *6.49~6.66* | | *9.7~21.5* | | *8.9~16.0* | | *10.3~17.5* | | *23~52* | | *21~37* | | *26~40* | | | |
| Stage III (Early Paleozoic) | | | | | | | | | | | | | | | | | | | | | | | |
| Timanide | 1 | 530-500 | EU | 35.0 | 1.4 | 2.86 | 0.00 | 6.56 | 0.01 | 13.8 | 0.9 | 9.1 | 1.2 | 12.1 | 0.9 | 39 | 3 | 26 | 3 | 35 | 2 | 31 | Ivanova et al., 2011 |
| Lachlan | 2 | 440-380 | AU | 45.8 | 1.9 | 2.85 | 0.00 | 6.54 | 0.01 | 14.5 | 1.7 | 11.7 | 4.4 | 19.6 | 4.3 | 32 | 3 | 26 | 10 | 43 | 8 | 56 | Finlayson et al., 2002 |
| Appalachian | 3 | 470-360 | NA | 36.5 | 2.0 | 2.83 | 0.01 | 6.45 | 0.03 | 17.9 | 5.4 | 11.2 | 1.5 | 7.4 | 7.7 | 50 | 17 | 31 | 4 | 20 | 20 | 27 | Hughes and Luetgert, 1991<br>Hughes et al., 1994 |
| Caledonian | 4 | 480-400 | EU | 33.8 | 4.1 | 2.83 | 0.01 | 6.47 | 0.04 | 11.3 | 2.5 | 14.1 | 6.0 | 8.5 | 3.5 | 33 | 6 | 41 | 14 | 26 | 12 | 34 | Landes et al., 2005<br>Stratford and Thybo, 2011b<br>Schmidt-Aursch and Jokat, 2005 |
| Kunlun | 5 | 430-400 | AS | 56.3 | 9.1 | 2.80 | 0.01 | 6.35 | 0.05 | 36.3 | 5.4 | 14.8 | 6.7 | 5.2 | 5.0 | 65 | 11 | 26 | 9 | 9 | 8 | 364 | Jia et al., 2019<br>Teng et al., 2014<br>Zhang et al., 2013 |
| Tienshan | 6 | 440-410 | AS | 51.9 | 6.5 | 2.84 | 0.02 | 6.49 | 0.07 | 27.8 | 2.5 | 13.8 | 4.7 | 16.2 | 3.7 | 43 | 7 | 26 | 7 | 31 | 4 | 127 | Li et al., 2001 |
| Altia | 7 | 440-411 | AS | 55.3 | 0.3 | 2.80 | 0.00 | 6.41 | 0.00 | 27.8 | 0.6 | 18.0 | 0.6 | 9.5 | 0.5 | 50 | 1 | 33 | 1 | 17 | 1 | 33 | Bai et al., 2023 |
| Cathasia | 8 | 425-400 | AS | 32.1 | 2.2 | 2.81 | 0.00 | 6.40 | 0.01 | 17.2 | 2.3 | 9.5 | 3.0 | 5.4 | 1.1 | 54 | 6 | 30 | 9 | 17 | 4 | 54 | Zhang et al., 2005<br>Zhang et al., 2007 |
| Ribeira | 9 | 620-470 | SA | 31.8 | 0.2 | 2.78 | 0.00 | 6.28 | 0.00 | 18.7 | 0.2 | 13.0 | 0.3 | 0.0 | 0.0 | 59 | 1 | 41 | 1 | 0 | 0 | 128 | Bernardes et al., 2023 |
| *Ranges* | | | | *31.8~56.3* | | *2.78~2.86* | | *6.28~6.56* | | *11.3~36.3* | | *9.1~18.0* | | *0~19.6* | | *32~65* | | *26~41* | | *0~43* | | | |
| Stage IV (Late Paleozoic - Mesozoic) | | | | | | | | | | | | | | | | | | | | | | | |
| Urals | 1 | 300-250 | EU | 47.7 | 4.5 | 2.82 | 0.01 | 6.42 | 0.03 | 20.3 | 1.9 | 15.7 | 2.4 | 11.8 | 4.0 | 43 | 3 | 33 | 7 | 24 | 7 | 10 | Carbonell et al., 2000<br>Druzhimin et al., 1997 |
| Dabie | 2 | 240-200 | AS | 36.8 | 3.3 | 2.81 | 0.01 | 6.41 | 0.04 | 18.2 | 3.8 | 15.8 | 3.8 | 2.8 | 1.6 | 50 | 9 | 43 | 10 | 7 | 4 | 76 | Bai et al., 2007<br>Liu et al., 2003 |
| Mongol-Okhotsk | 3 | 380-270 | AS | 41.2 | 0.6 | 2.81 | 0.01 | 6.37 | 0.03 | 24.8 | 2.0 | 13.5 | 0.8 | 2.9 | 1.6 | 60 | 4 | 33 | 2 | 7 | 4 | 37 | Soloviev et al., 2020 |
| New England | 4 | 270-210 | AU | 34.6 | 0.0 | 2.78 | 0.00 | 6.29 | 0.00 | 23.3 | 0.0 | 11.3 | 0.0 | 0.0 | 0.0 | 67 | 0 | 33 | 0 | 0 | 0 | 19 | Finlayson and Collins, 1993 |
| Vasican | 5 | 370-290 | EU | 30.3 | 2.4 | 2.81 | 0.02 | 6.37 | 0.06 | 16.2 | 3.8 | 12.5 | 4.2 | 1.6 | 1.9 | 54 | 15 | 42 | 15 | 7 | 5 | 107 | Aichroth et al., 1992<br>Landes et al., 2005<br>ILIHA DSS Group, 1993 |
| *Ranges* | | | | *30.3~47.7* | | *2.78~2.82* | | *6.29~6.42* | | *16.2~24.8* | | *11.3~15.8* | | *0~11.8* | | *43~67* | | *33~43* | | *0~24* | | | |
| Stage V (Cenozoic) | | | | | | | | | | | | | | | | | | | | | | | |
| Alpine | 1 | 120-0 | EU | 39.7 | 6.6 | 2.79 | 0.01 | 6.30 | 0.02 | 25.5 | 5.4 | 14.2 | 4.5 | 0.0 | 0.0 | 64 | 9 | 36 | 9 | 0 | 0 | 225 | Pedreira et al., 2003<br>Ayarza et al., 2014<br>Ye et al., 1995<br>Scarascia and Cassinis, 1997<br>Bruckl et al., 2007 |
| Cordillera | 2 | 150-0 | NA | 34.8 | 1.3 | 2.80 | 0.01 | 6.36 | 0.05 | 20.7 | 4.4 | 14.2 | 4.1 | 0.0 | 0.0 | 59 | 12 | 41 | 12 | 0 | 0 | 145 | Clowes et al., 2005<br>Spence and Mclean, 1998<br>Welford et al., 2001 |
| Kolyma | 3 | 160-60 | AS | 41.2 | 0.6 | 2.81 | 0.01 | 6.37 | 0.03 | 24.8 | 2.0 | 13.5 | 0.8 | 2.9 | 1.6 | 60 | 4 | 33 | 2 | 7 | 4 | 45 | Soloviev et al., 2020 |
| Lhasa, Tibet | 4 | 120-0 | AS | 69.9 | 1.9 | 2.81 | 0.00 | 6.41 | 0.01 | 31.6 | 0.9 | 38.2 | 2.2 | 0.0 | 0.0 | 45 | 2 | 55 | 2 | 0 | 0 | 39 | Wang et al., 2021 |
| *Ranges* | | | | *34.8~69.9* | | *2.79~2.81* | | *6.30~6.41* | | *20.7~31.6* | | *13.5~38.2* | | *0~2.9* | | *45~64* | | *33~55* | | *0~7* | | | |

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