Supplementary Data Table DR1: Source of data used for each of the tectonostratigraphic basin types plotted in Figures 1-3 and Supplementary Data File Figure 1.

Tectonostratigraphic basin type	Depositional age	Curve name	Reference
Convergent plate settings			
Forearc sandstones, Southern California*	65 Ma	Fore-arc 1	Jacobson et al., 2011
Forearc sandstones, Great Valley Group	136 to 72 Ma	Fore-arc 2	DeGraaff-Surpless et al., 2002
Trench volcanogenic sandstones, Terra Australis Orogen	315 Ma	Trench (volc.)	Korsch et al., 2009
Trench quartz-rich sandstones, Terra Australis Orogen	315 Ma	Trench (Qtz-rich)	Korsch et al., 2009
Macquarie arc	480 to 450 Ma	Intra-arc	Glen et al., 2010
Back arc sedimentary rocks and S-type granites, Terra Australis Orogen*	460 Ma	Back-arc	Kemp et al., 2006; Fergusson & Fanning, 2002
Collisional settings			
Foreland basin, Cordilleran Orogen*	65 Ma	Foreland 1	Fuentes et al., 2011
Foreland basin sandstones, Appalachian orogen*	350 Ma	Foreland 2	Park et al., 2010
Foreland basin sandstones, Grenville Orogen (Torridon Group)	1000 Ma	Foreland 3	Rainbird et al., 2001
Foreland basin sandstones, Grenville Orogen (Middle Run Formation)	950 Ma	Foreland 4	Santos et al., 2002
Indus and Ganges rivers	0 Ma	Foreland 5	Clift et al., 2004; Campbell et al., 2005
Extensional settings			
Rift basin, Caledonian Orogen, (upper Dalradian Supergroup)	550 Ma	Rift 1	Cawood et al., 2003
Rift basin – Perth Basin*	240 Ma	Rift 2	Cawood & Nemchin, 2000
Passive margin, Caledonian Orogen (Eriboll Formation)	520 Ma	Pass-Margin 1	Cawood et al., 2007
Passive margin, Eastern Australia	0 Ma	Pass-Margin 2	Sircombe, 1999
Passive margin, Western Australia*	0 Ma	Pass-Margin 3	Sircombe & Freeman, 1999

Bangemall Supergroup, West Australian craton, Packages 1-4	1465 Ma	Intr-crat. Bas. 1	Martin et al., 2008
Bangemall Supergroup, , West Australian craton, Package 5	1070 Ma	Intr-crat. Bas. 2	Martin et al., 2008
Unknown settings			
Krummedal sequence, Caledonian Orogen	950 Ma	Krummendal	Strachan et al., 1995; Kalsbeek et al., 2000; Watt et al., 2000; Watt & Thrane, 2001; Leslie & Nutman, 2003
Moine Supergroup, Caledonian Orogen	900 Ma	Moine	Friend et al., 2003; Cawood et al., 2004; Kirkland et al., 2008
Mt Isa, North Australian craton	1690 Ma, 1660 Ma	Mt Isa	Neumann et al., 2009
Isua Belt, North Atlantic craton	3650 Ma	Isua	Nutman et al., 2009
Jack Hills Proterozoic, Yilgarn craton	1200 & 1000 Ma	Jack Hills (Proterozoic)	Cavosie et al., 2004; Dunn et al., 2005
Jack Hills Archean, Yilgarn craton	3000 & 2650 Ma	Jack Hills (Archean)	Cavosie et al., 2004; Crowley et al., 2005; Dunn et al., 2005; Eriksson & Wilde, 2011
Avalonia, Northern Appalachian Orogen, Broad Rive Group	620 Ma	Avalonia-1	Barr et al. 2012
Avalonia, Northern Appalachian Orogen, Glen Falls	530 Ma	Avalonia-2	Barr et al. 2012
Avalonia, Northern Appalachian Orogen, King Square	500 Ma	Avalonia-3	Barr et al. 2012

Note: Depositional age based on youngest depositional age where a range of ages within a depositional sequence; either due to uncertainty in age or grouping of multiple samples with a range of ages. For samples from unknown tectonic settings where uncertainty in the depositional age may range over hundreds of millions of years (e.g. successions in Jack Hills) both maximum and minimum depositional ages were used to calculate the plotted curves. Abbreviations: volc. – volcaniclastic sandstones; Qtz-rich – quartz-rich sandstone; Pass-Margin – passive margin; Intr-crat Bas. – intra-cratonic basin. Basin types marked with an asterisk are plotted on figure 1.

References for data used in construction of figures 1 and 2 and supplementary data file figure 1.

Barr, S.M., Hamilton, M.A., Samson S.D., Satkoski, A.M., White, C.E., 2012. Provenance variations in northern Appalachian Avalonia based on detrital zircon age patterns in Ediacaran and Cambrian sedimentary rocks, New Brunswick and Nova Scotia, Canada Canadian Journal of Earth Science, 49: 533–546.

Campbell, I.H., Reiners, P.W., Allen, C.M., Nicolescu, S., Upadhyay, R., 2005. He–Pb double dating of detrital zircons from the Ganges and Indus Rivers: Implication for quantifying sediment recycling and provenance studies. Earth and Planetary Science Letters, 237: 402-432.

Cavosie, A.J., Wilde, S.A., Liu, D., Weiblen, P.W., Valley, J.W., 2004. Internal zoning and U–Th–Pb chemistry of Jack Hills detrital zircons: a mineral record of early Archean to Mesoproterozoic (4348–1576 Ma) magmatism. Precambrian Research, 135: 251-279.

Cawood, P.A., Nemchin, A.A., 2000. Provenance record of a rift basin: U/Pb ages of detrital zircons from the Perth Basin, Western Australia. Sedimentary Geology, 134: 209-234.

Cawood, P.A., Nemchin, A.A., Smith, M., Loewy, S., 2003. Source of the Dalradian Supergroup constrained by U-Pb dating of detrital zircon and implications for the East Laurentian margin. Journal of the Geological Society, London, 160: 231-246.

Cawood, P.A., Nemchin, A.A., Strachan, R., 2007. Provenance record of Laurentian passive-margin strata in the northern Caledonides: Implications for paleodrainage and paleogeography. Geological Society of America Bulletin, 119: 993-1003.

Cawood, P.A., Nemchin, A.A., Strachan, R.A., Kinny, P.D., Loewy, S., 2004. Laurentian provenance and an intracratonic tectonic setting for the Moine Supergroup, Scotland, constrained by detrital zircons from the Loch Eil and Glen Urquhart successions. Journal of the Geological Society, London, 161: 861-874.

Clift, P.D., Campbell, I.H., Pringle, M.S., Carter, A., Zhang, X., Hodges, K.V., Khan, A.A., Allen, C.M., 2004. Thermochronology of the modern Indus River bedload: New insight into the controls on the marine stratigraphic record. Tectonics, 23: TC5013, doi:10.1029/2003TC001559.

Crowley, J.L., Myers, J.S., Sylvester, P.J., Cox, R.A., 2005. Detrital Zircon from the Jack Hills and Mount Narryer, Western Australia: Evidence for Diverse >4.0 Ga Source Rocks. The Journal of Geology, 113: 239-263.

DeGraaff-Surpless, K., Graham, S.A., Wooden, J.L., McWilliams, M.O., 2002. Detrital zircon provenance analysis of the Great Valley Group, California: Evolution of an arc-forearc system. Geological Society of America Bulletin, 114: 1564-1580.

Dunn, S.J., Nemchin, A.A., Cawood, P.A., Pidgeon, R.T., 2005. Provenance record of the Jack Hills metasedimentary belt: Source of the Earth's oldest zircons. Precambrian Research, 138: 235-254.

Eriksson, K.A., Wilde, S.A., 2011. Palaeoenvironmental analysis of Archaean siliciclastic sedimentary rocks in the west–central Jack Hills belt, Western Australia with new constraints on ages and correlations. Journal of the Geological Society, London, 167: 827-840.

Fergusson, C.L., Fanning, C.M., 2002. Late Ordovician stratigraphy, zircon provenance and tectonics, Lachlan Fold Belt, southeastern Australia. Australian Journal of Earth Sciences, 49: 423-436.

Friend, C.R.L., Strachan, R.A., Kinny, P.D., Watt, G.R., 2003. Provenance of the moine Supergroup of NW Scotland: evidence from geochronology of detrital and inherited zircons from (meta)sedimentary rocks, granites and migmatites. Journal of the Geological Society, London, 160: 247-257.

Fuentes, F., DeCelles, P.G., Constenius, K.N., Gehrels, G.E., 2011. Evolution of the Cordilleran foreland basin system in northwestern Montana, U.S.A. Geological Society of America Bulletin, 123: 507-533.

Glen, R.A., Saeed, A., Quinn, C.D., Griffin, W.L., 2011. U–Pb and Hf isotope data from zircons in the Macquarie Arc, Lachlan Orogen: Implications for arc evolution and Ordovician palaeogeography along part of the east Gondwana margin. Gondwana Research, 19: 670-685.

Jacobson, C.E., Grove, M., Pedrick, J.N., Barth, A.P., Marsaglia, K.M., Gehrels, G.E., Nourse, J.A., 2011. Late Cretaceous–early Cenozoic tectonic evolution of the southern California margin inferred from provenance of trench and forearc sediments Geological Society of America Bulletin, 123: 485-506.

Kalsbeek, F., Thrane, K., Nutman, A.P., Jepsen, H.F., 2000. Late Mezoproterozoic to early Neoproterozoic history of the East Greenland Caledonides: evidence for Greenvillian orogenesis? Journal of the Geological Society, London, 157: 1215-1225.

Kemp, A.I.S., Hawkesworth, C.J., Paterson, B.A., Kinny, P.D., 2006. Episodic growth of the Gondwana supercontinent from hafnium and oxygen isotope ratios. Nature, 439: 580-583.

Kirkland, C.L., Strachan, R.A., Prave, A.R., 2008. Detrital zircon signature of the Moine Supergroup, Scotland: Contrasts and comparisons with other Neoproterozoic successions within the circum-North Atlantic region. Precambrian Research, 163: 332-350.

Korsch, R.J., Adams, C.J., Black, L.P., Foster, D.A., Fraser, G.L., Murray, C.G., Foudoulis, C., Griffin, W.L., 2009. Geochronology and provenance of the Late Paleozoic accretionary wedge and Gympie Terrane, New England Orogen, eastern Australia. Australian Journal of Earth Sciences, 56: 655-685.

Leslie, A.G., Nutman, A.P., 2003. Evidence for Neoproterozoic orogenesis and early high temperature Scandian deformation events in the southern East Greenland Caledonides. Geological Magazine, 140: 309-333.

Martin, D.M., Sircombe, K.N., Thorne, A.M., Cawood, P.A., Nemchin, A.A., 2008. Provenance history of the Bangemall Supergroup and implications for the Mesoproterozoic paleogeography of the West Australian Craton. Precambrian Research, 166: 93-110.

Neumann, N.L., Southgate, P.N., Gibson, G.M., 2009. Defining unconformities in Proterozoic sedimentary basins using detrital geochronology and basin analysis – An example from the Mount Isa Inlier, Australia. Precambrian Research, 168: 149-166.

Nutman, A.P., Friend, C.R.L., Paxton, S., 2009. Detrital zircon sedimentary provenance ages for the Eoarchaean Isua supracrustal belt southern West Greenland: Juxtaposition of an imbricated ca. 3700 Ma juvenile arc against an older complex with 3920–3760 Ma components. Precambrian Research, 172: 212-233.

Park, H., Barbeau Jr., D.L., Rickenbaker, A., Bachmann-Krug, D., Gehrels, G., 2010. Application of Foreland Basin Detrital-Zircon Geochronology to the Reconstruction of the Southern and Central Appalachian Orogen. The Journal of Geology, 118: 23-44.

Rainbird, R.H., Hamilton, M.A., Young, G.M., 2001. Detrital zircon geochronology an provenance of the Torridonian, NW Scotland. Journal of the Geological Society, London, 158: 15-27.

Santos, J.O.S., Hartmann, L.A., McNaughton, N.J., Easton, R.M., Rea, R.G., Potter, P.E., 2002. Sensitive high resolution ion microprobe (SHRIMP) detrital zircon geochronology provides new evidence for a hidden Neoproterozoic foreland basin to the Grenville Orogen in the eastern Midwest, U.S.A. Canadian Journal of Earth Sciences, 39: 1505-1515.

Sircombe, K., 1999. Tracing provenance through the isotope ages of littoral and sedimentary detrital zircon, eastern Australia. Sedimentary Geology, 124: 47-67.

Sircombe, K.N., Freeman, M.J., 1999. Provenance of detrital zircons on the Western Australia coastline – Implications for the geologic history of the Perth basin and denudation of the Yilgarn craton. Geology, 27: 879-882.

Strachan, R.A., Nutman, A.P., Friderichsen, J.D., 1995. SHRIMP U-Pb geochronology and metamorphic history of the Smallefjord sequence, NE Greenland Caledonides. Journal of the Geological Society, London, 152: 779-784.

Watt, G.R., Kinny, P.D., Friderichsen, J.D., 2000. U-Pb geochronology of Neoproterozoic and Caledonian tectonothermal events in the East Greenland Caledonides. Journal of the Geological Society, London, 157: 1031-1048.

Watt, G.R., Thrane, K., 2001. Early Neoproterozoic events in East Greenland. Precambrian Research, 110: 165-184.

Wu, F.-Y., Clift, P.D., Yang, J.-H., 2007. Zircon Hf isotopic constraints on the sources of the Indus Molasse, Ladakh Himalaya, India. Tectonics, 26: TC2014, doi:10.1029/2006TC002051.

Data Repository Figure Caption

DR Figure 1: Patterns of CA-DA for a series of structurally disrupted and metamorphosed sedimentary successions. Data references are given in the online supplementary information file. Red curves (i.e. Isua, Mt Isa, Avalonia-1 and Avalonia-2) plot within the field for convergent basins (red field A in Figure 3), blue curves (Moine and Krummedal) i.e. plot within the field for collisional basins (blue field B in Figure 3), green curves (Jack Hills sedimentary successions deposited both in the Archaean and in the Proterozoic) plot within the field for extensional basins (green field C in Figure 3).The black curve, labelled Avalonia-3 refers to a sample from the Avalonia continental fragment which lots in field B but on the basis of regional relations accumulated in an extensional basin setting. The multiple curves for the Jack Hills reflect the uncertainty over the deposition age of the sediments (values in Ma are given along the curves).

Cawood et al. DR Fig. 1