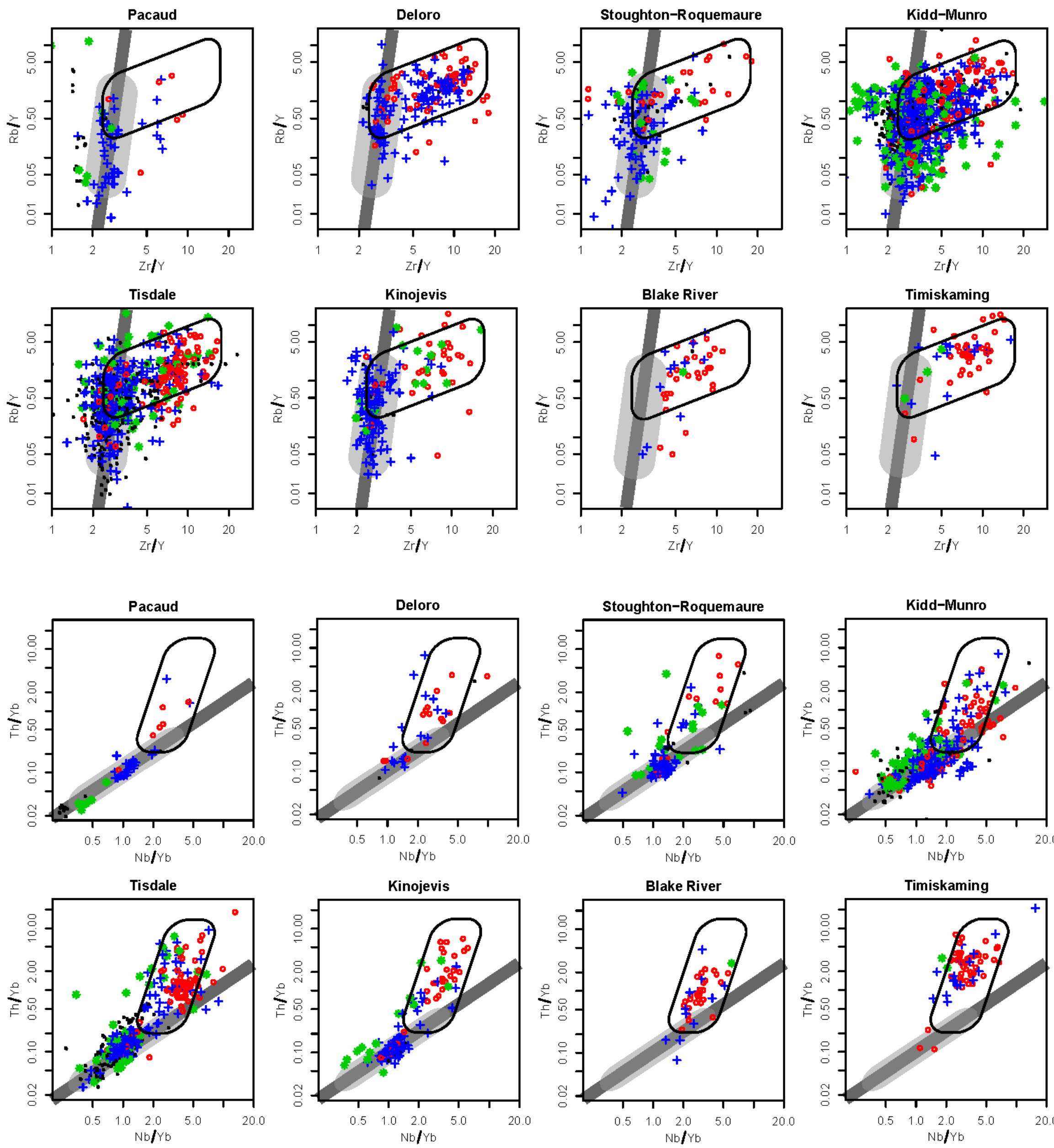
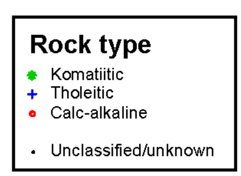
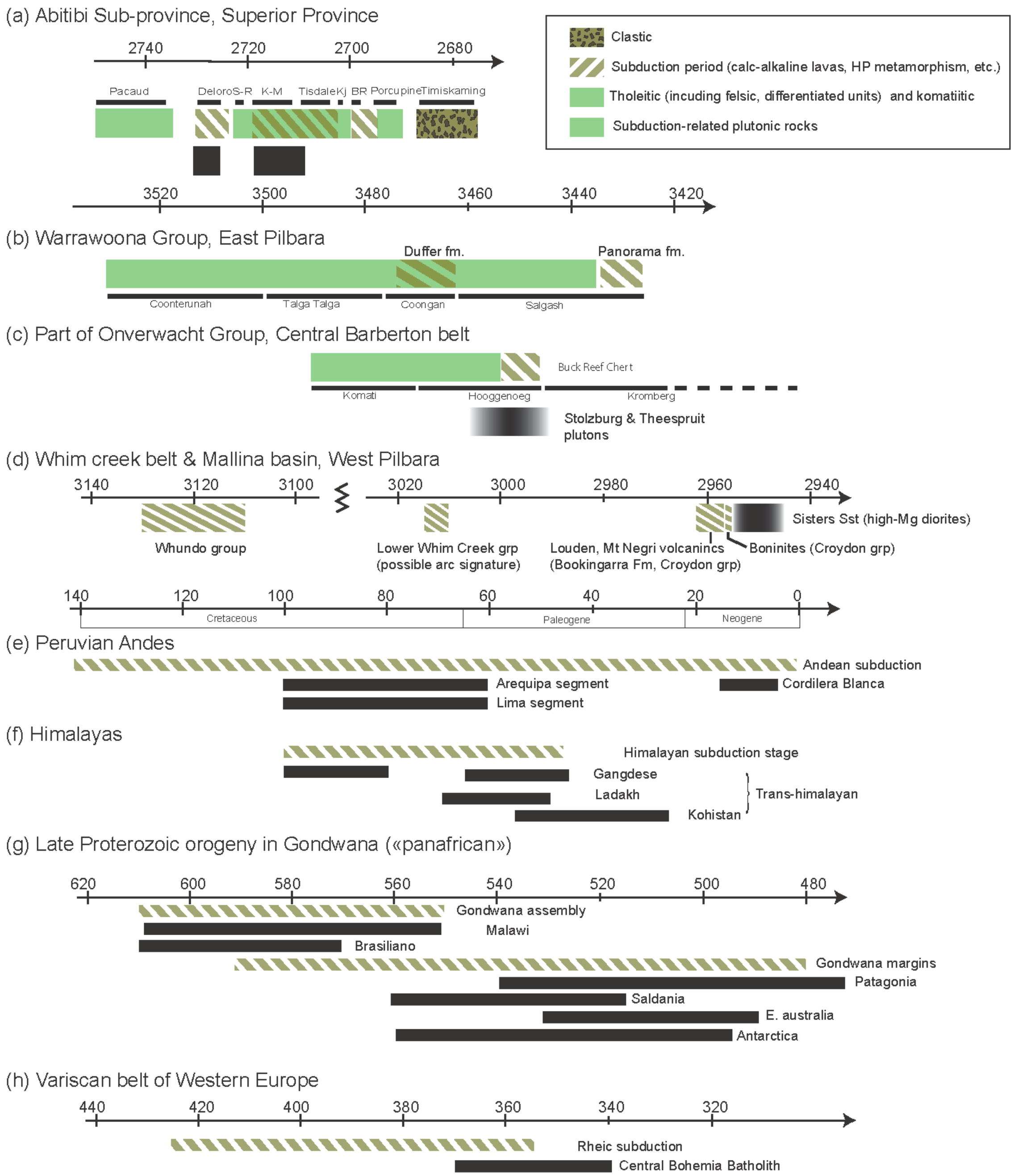


Supplementary Figure DR1: Geochemical features of mafic rocks (SiO_2 <62%) for all the assemblages used in figure 1, using Rb/Y vs. Zr/Y and Th/Yb vs. Nb/Yb (Pearce and Peate, 1995) diagrams. Dark grey line: mantle array; grey field: tholeitic basalts; thick black line: field of "arc" signatures. Symbols reflect the major elements characteristics of the samples, based on Jensen (1976) classification: circles – calc-alkaline; cross: komatiitic; stars: tholeitic. The main criteria to classify an assemblage as "arc" or "non-arc" are (i) the position in these diagrams (omitting outliers); (ii) the presence or absence of komatiites; (iii) the existence of intermediate to acid calc-alkaline lavas (not plotted here). See details in Benn and Moyen, 2008; Kerrich et al., 1999a; Kerrich et al., 1999b; Sproule et al., 2002; Wyman, 2003; Wyman et al., 2002.





Supplementary Fig. DR2: Comparison between the duration of Archaean « arc » events and recent subduction periods. a—d: examples of Archaean events, showing the period with an "arc" magmatism and the period dominated by tholeitic to komatiic activity (mostly mafic/ultramafic but in some cases, e.g. East Pilbara, there may be intervening felsic events with the same affinity (Moyen, 2010; Smithies et al., 2007b)). Black boxes correspond to periods of plutonic acticity with a demonstrable deep origin (subduction), either the "high pressure TTGs" (Moyen, 2010) or sanukitoids. Hatched boxes correspond to "recorded" subduction events (with a clear geological record such as HP metamorphism, magmatic arc, etc.), and black boxes to cacl-alkaline batholiths interpreted as subduction related. A: Abitibi sub-province, after (Benn and Moyen, 2008). B: Warrawoona Group of the East Pilbara (Smithies et al., 2007a; Van Kranendonk et al., 2007); C: Middle part of the Onverwacht group of the Barberton Greenstone Belt, S. Africa (Lowe and Byerly, 2007); (d) Whim Creek and Mallina basins of the Western Pilbara, Australia (Smithies et al., 2005; Smithies and Champion, 2000; Smithies et al., 2004b). E-h: for reference, timeline of neoproterozoic and younger events, using the same time scale and caption. E: Peruvian Andes and coastal batholiths (Soler and Bonhomme, 1990). F: Himalayas and Asia-Eurasia convergence, and Trans-Himalayan batholith(Weinberg and Dunlap, 2000; Wen et al., 2008). G: Late-Proterozoic "panafrican" orogenic system, from the compilation in (Cawood and Buchan, 2007). H: Hercynian belt of W. Europe and Bohemian batholith (Collins, 2003; Janousek et al., 2006).

Movie DR1: numerical modelling setup and model animation.

All geodynamical model calculations are performed with the numerical finite element code Sepran (Segal and Praagman, 2011). Subduction dynamics are solved using conservation of mass, momentum, thermal energy, and composition in a two-dimensional, 3600x2000-km large model domain, with a composite, stress, temperature, pressure, and composition dependent rheology. Basaltic oceanic crust is weaker than mantle material under the same conditions, and transforms to eclogite at depth over time. The dominant mantle phase transitions from olivine to spinel and spinel to perovskite/magnesiowüstite are included, as they significantly affect the dynamics of downgoing slabs. Further details of the model setup and applied 'default' model parameters are listed in (van Hunen and van den Berg, 2008). An animation of the slab break-off process during subduction in a hotter mantle is available as online supplementary material. The animation illustrates how subduction is repeatedly interrupted by slab break-off.

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