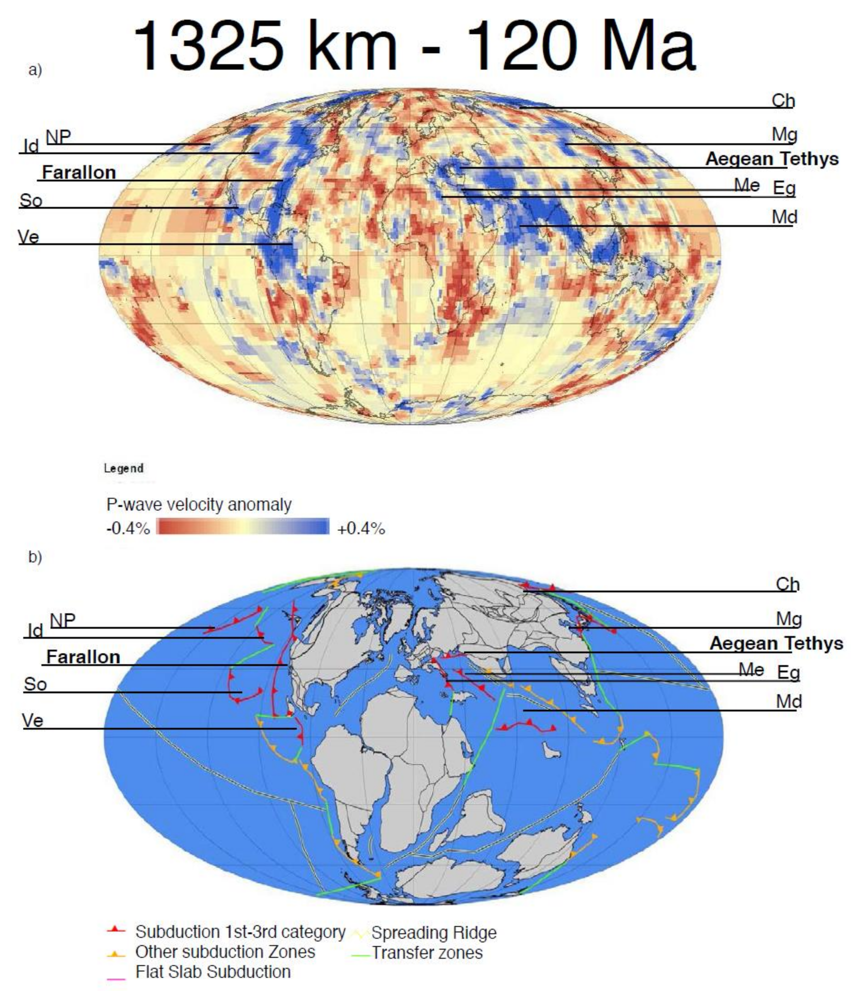
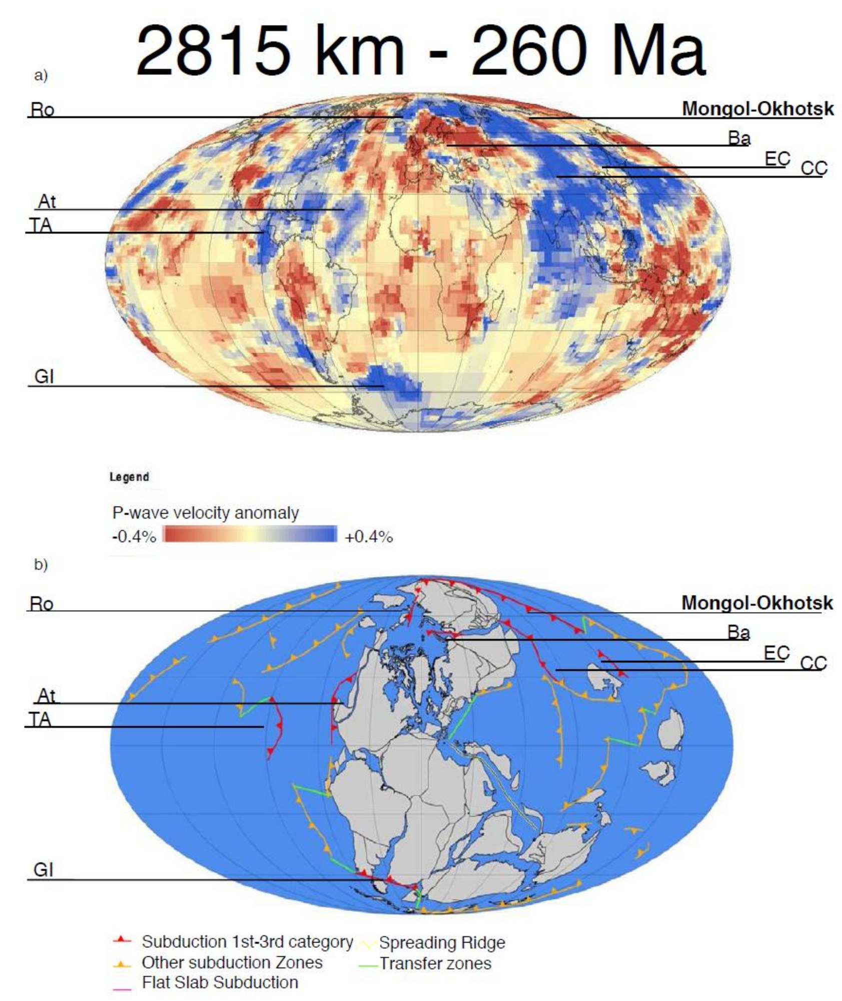
Towards absolute plate motions constrained by lower mantle slab remnants.

D. van der meer[1,2,*] , W. Spakman[1,*] , D. van Hinsbergen[1,3,4], M. Amaru[1,5] & T. Torsvik[3,4,6] *(Nature geoscience, 2010)*

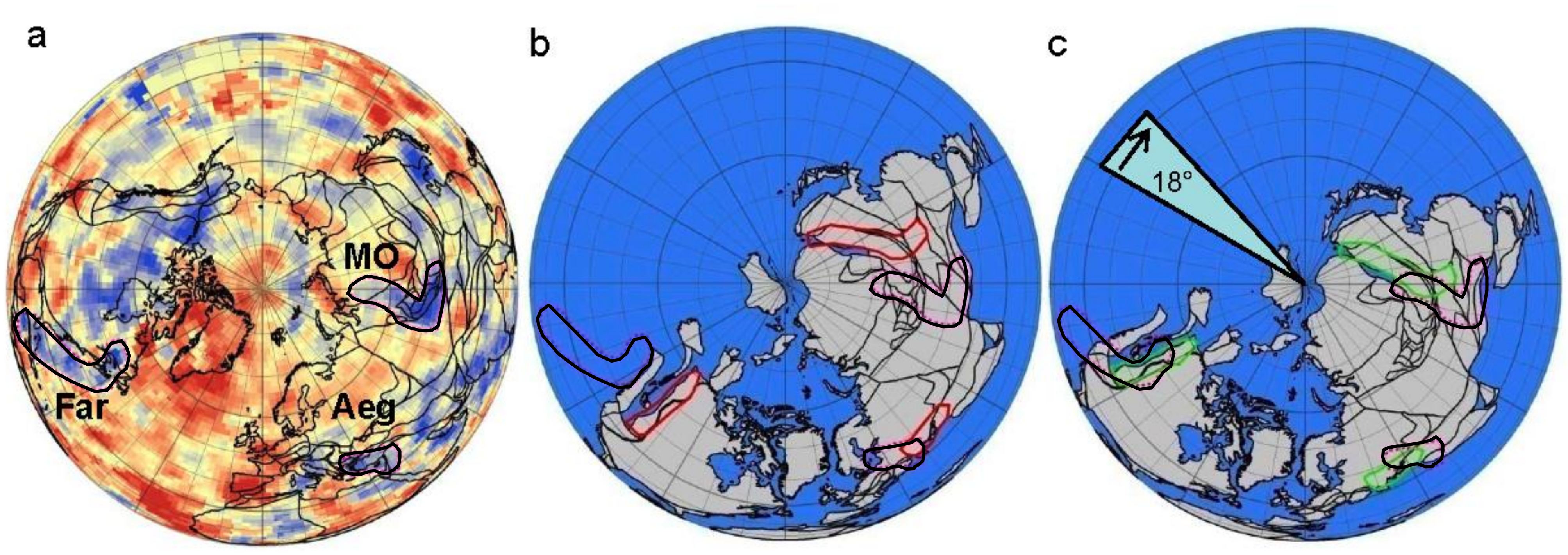
Since the first reconstruction of the supercontinent Pangaea, key advances in plate tectonic reconstructions have been made. **Although the movement of tectonic plates since the start of the mid-Cretaceous period (100 million years (Myr) ago) is relatively well understood the longitudinal position of plates before this period is not constrained at all.**

Here, we use a global mantle tomography model UU-P07 to estimate the longitude of past oceanic subduction zones. **We identify 28 remnants of oceanic plates that were subducted into the lower mantle and link these to the mountain building zones from which they are likely to have originated**. Assuming that these remnants sank vertically through the mantle, we reconstruct the longitude at which they were subducted.



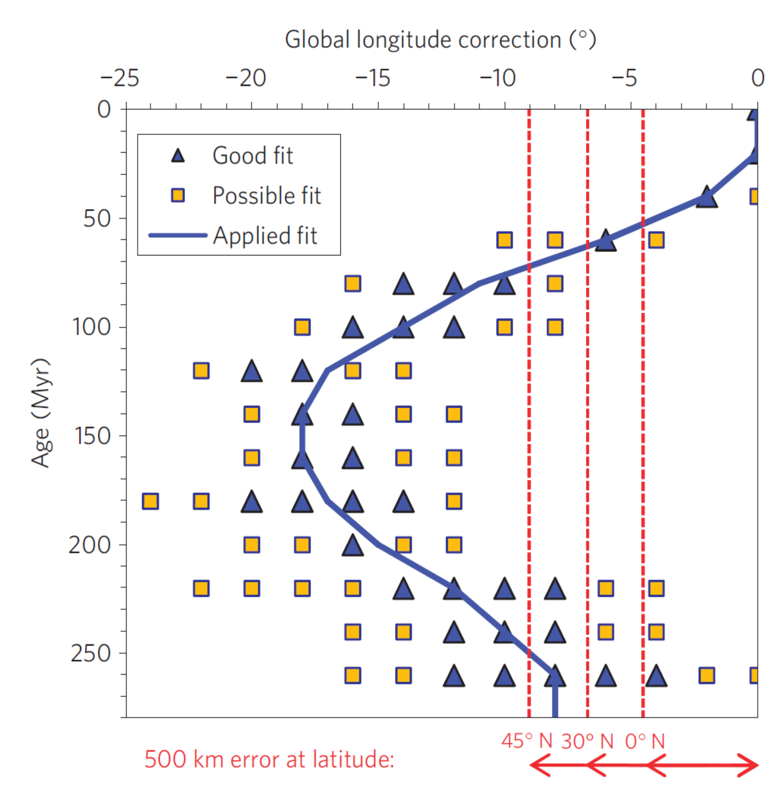


Our estimates for the location of the subduction zones are offset by up to 18° compared with an absolute plate motion model based on the moving-hotspot assumption and requiring no longitudinal motion of Africa before 80 Myr. **The good correspondence of both independent approaches, our 'slab-frame' and the 'moving hotspot frame' gives confidence that we can converge to one absolute plate motion frame.**

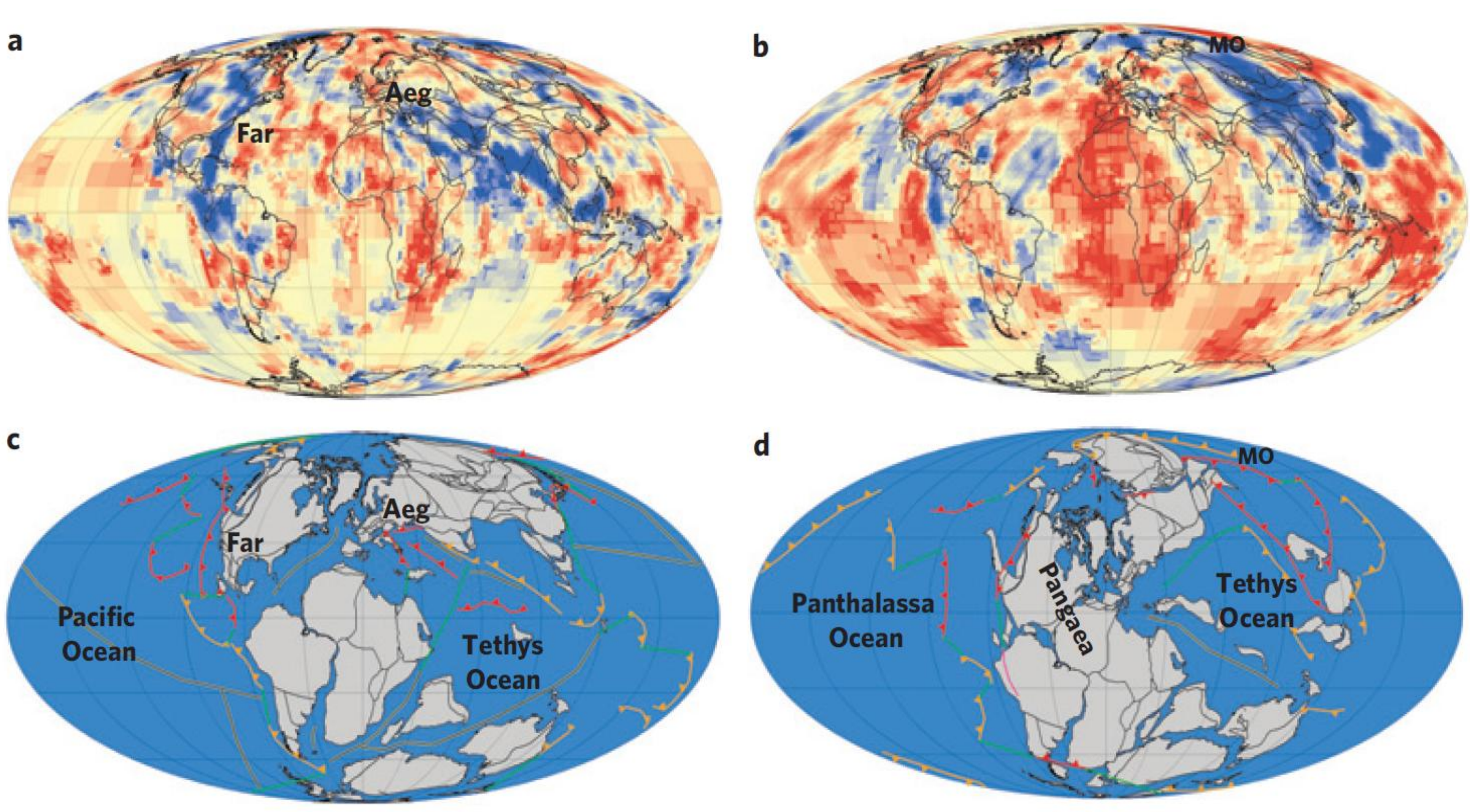


The relative positions of continental blocks in the absolute plate reconstruction of Torsvik et al. (2008) are fairly consistent with the relative position of palaeo-subduction zones inferred from tomography.

To first order, at each period only a longitudinal shift is required of the entire continental assembly to obtain a match with slab remnants representing palaeo-subduction zones

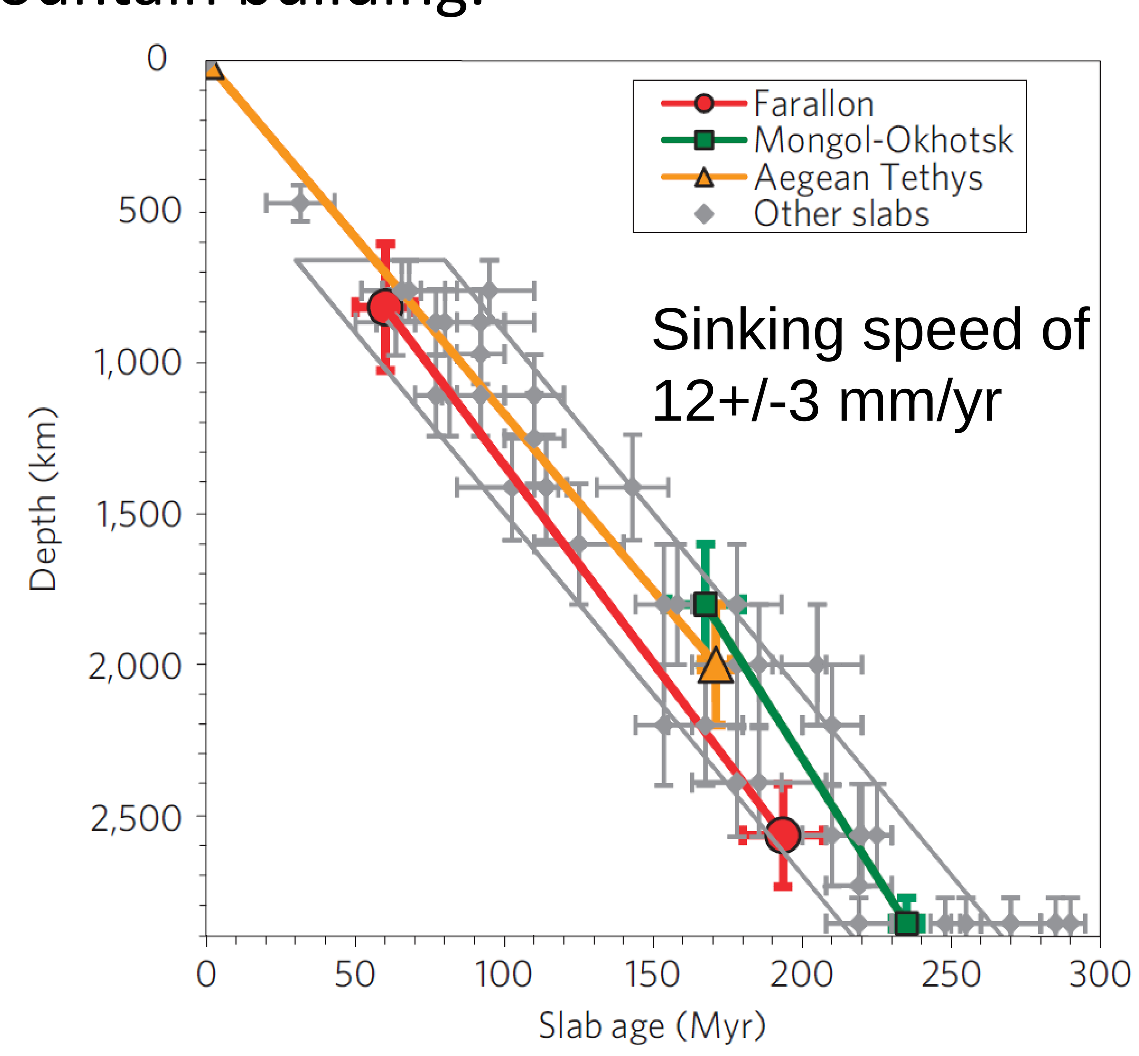


We did not detect oceanic plate remnants from the Carboniferous period (300–360 Myr ago), or before, suggesting that the tomographic visibility of subduction is limited to the past 300 Myr.



Example of Longitude-corrected plate tectonic reconstructions. A good fit is obtained between the tomographic depth slices at 1,325 km (a) and 2,650 km (b) depth and the modified plate tectonic reconstructions at 120 Myr (17° corrected) (c) and 240 Myr (10° corrected) (d). Tectonic interpretation: lines with triangles, subduction zone of the slab data set (red) and other slabs with only a qualitative interpretation (orange); green line, transform zone; yellow double line, spreading ridge

An important spin-off is the determination of an **average sinking velocity of slab remnants in the lower mantle of 12 +/-3 mm/yr**. This is obtained independent of notions of lower mantle rheology and is purely determined by our correlation between lab remnants and mountain building.



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