1. Rapid changes in plate motion rate

Novel data from marine magnetic anomalies indicate that rapid changes, within ∼5 Ma, in plate motion rate can occur in a single plate (Figure 1). Variations in plate motion are often associated with major changes in boundary forces or tectonic setting, however these changes either occur gradually over large time scales or instan- 
taneously and they can not be explained through plate tectonics. Slab buckling in the mantle transition zone (MTZ) explains the order of magnitude decrease in slab velocity at the surface and in the lower mantle, but it is also expressed in the forward and backward draping slab in the upper mantle. This changes the slab dip at the subduction con- tact and potentially the speed and style of sub- duction due to changes in the force balance.

We show that slab buckling can explain short-term changes in plate periodicity and plate motion of both the subducting and over- riding plate and that the average subduction- 
plate speed controls the amplitude and period of these plate motion changes.

3. Amplitude and Period of plate motions

Besides differences in allowed trench motion (stationary vs. rollback) we also change the age of the subducting plate (SP) and overriding plate (OP), or the viscosity of the weak crustal layer (Figure 5B-C). The effect of the SP age is less profound, although amplitudes for the models with stationary trenches are always lower than for models with roll- back and subduction therefore occurs relatively constant (Figure 3B). 

2. 2D subduction with free or fixed overriding plate

In plate tectonic reconstructions, oceanic plates are reconstructed through marine magnetic reversals, gener- ally on 3-10 Ma time-scales for each stage of rotation (Larson Poles). If the buckling of slabs has a profound effect on the velocity of subducting plates, we could have missed several stages of faster and slower moving tectonic plates. DeMets and Mercier (1991) showed that higher resolution data can be obtained from oceanic plates and we show (Figure 6) that a sampling interval of 5 Ma per stage can already smooth the rapid oscillations ob- 
tained from subduction zones with globally average subduction speeds (e.g. 6 cm/yr).

Furthermore, these oscillations occur also in the OP (figure 3A, 4A-B), meaning that OP-extension, back-arc basin opening, volcanism and/or magmatism might also show periodic oscillations as an effect of slab buckling. This would mean that deformation and ore formation could also be periodic and that insights in these fields of study could also benefit from higher resolution data and/or reconstructions.

4. Sampling interval - need for higher resolution data?

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1. High resolution marine data show rapid oscillations in plate motion rate

2. Slab buckling could be a viable mechanism to explain these oscillations

3. The amplitude and period depend on average subduction velocity

4a. Current resolution of marin data could miss these oscillations by smoothing stage rotations

4b. Oscillations in overriding plate deformation might also be attributed to slab buckling

References

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Slab buckling as a driver for periodic and rapid (<5 Ma) changes in subduction speed and overriding plate deformation

Charles University Prague