Durham University
Department of Earth Sciences

Shaped by the past, creating the future

Durham, United Kingdom, Monday, 28 October 24

To: Doc. RNDr. Mirko Rokyta, CSc.
Dean of the MFF UK
Ke Karlovu 3
121 16 Prague 2
Czechia

Dear Prof. Mirko Rokyta,

I have read and examined the PhD thesis by Jakub Pokorný, entitled "*The role of rheology and water in the deformation of subducting slabs*". This PhD thesis addresses one of the major scientific questions in geodynamics: what is the fate of subducting lithospheric slabs when they sink into the mantle? This process provides a rare, but important opportunity to understand and verify the properties and dynamics of the Earth's mantle.

A significant body of literature already exists on the topic, but this thesis addresses and explores several new concepts, and provide significant new insight. Given the inherent uncertainty of several model parameters and the theoretical limits to the resolution of seismic imaging, the provided links between modelled dynamics and observables at the surface are particularly appreciated.

All presented research has a clear, well-presented rationale. The presented numerical models are carefully designed and well developed, which allows for state-of-the-art research. The results are presented in the context of existing research. Dynamics are carefully examined using extensive parameter sensitivity studies. As a result, the presented work is of high quality, which is further corroborated by the fact that several chapters of this work are already published in peer-reviewed international scientific journals.

The thesis is, in my opinion, well-presented, starting with an elaborate introduction and literature study, which provides a rationale for the work, and how it links to the key and recent related literature. After that, a useful background on oceanic lithosphere is provided in Chapter 1, including a nice overview on how water is mobilised, affects density and strength of subducting slabs, and through that

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subduction dynamics. This is followed by an in-depth description of the governing equations of the various physical processes in the numerical models in Chapter 2. After that, those numerical models are applied to a variety of related models on slab dynamics: Chapter 3 provides results on the slab dynamics using a realistic non-linear crustal rheology, particularly focussing on the ability of subducting slabs to buckle as they sink through the upper mantle, the mantle transition zone, and the lower mantle. Chapter 4 applies similar results to the Tonga subduction zone, which allows direct comparison with seismic observations. Chapter 5 applies results to the India-Africa-Eurasia plate system and shows how slab buckling can be coupled to observed plate speed variation. Chapter 6 finally discusses the role of slab dehydration and mantle wedge hydration on the slab dynamics. All figures are clear, and the thesis contains very few spelling mistakes. All this makes the thesis a pleasure to read.

To summarize, this PhD thesis clearly illustrates the author's ability to do creative scientific work, and I look forward to discussing the thesis further during the PhD defence.

Sincerely yours,

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