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Did Siberian plume arrive beneath West Siberia Basin or beneath Siberian Craton?

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The Permo-Triassic Siberian Traps – the type example and the largest continental Large Igneous Province, is located on both thick cratonic lithosphere of Precambrian Siberian Craton in the East Siberia and on much thinner lithosphere of the Mesozoic West Siberian Basin. Based on largest volumes of the exposed basalts and on highest source temperatures of basalts in the East Siberia, it is believed that the head of a hot mantle plume, which was probably the source of basalts, arrived in the East Siberia. However, there is no evidence of the expected pre-magmatic uplift nor of a large lithospheric stretching of the basaltic sequence in the East Siberia, while these features are reported for the West Siberian Basin [1]. Based on these observations it was suggested [1] that mantle plume head arrived to the base of the lithosphere of the West Siberian Basin and only later leaked below the East Siberian Craton (Figure 1).

Here I test scenarios with different locations of the mantle plume, using thermomechanical modeling technique. The model employs petrological constraints for the source composition and temperature [2], non-linear temperature- and stress-dependent elasto-visco-plastic rheology and pressure- and temperature-dependent melting of a heterogeneous mantle.

Modeling shows that observations for the West and East Siberian Traps can be reconciled for the large (more than 400 km in radius) and hot (potential temperature up to 1600°C) plume head containing large amount (up to 15 Wt%) of the recycled oceanic crust, that arrived to the thick lithosphere of the East Siberia and was then deflected towards the thin lithosphere of the West Siberia. In this case no uplift and stretching is generated in the East Siberia and major basaltic eruptions may occur first in the West Siberia.

References

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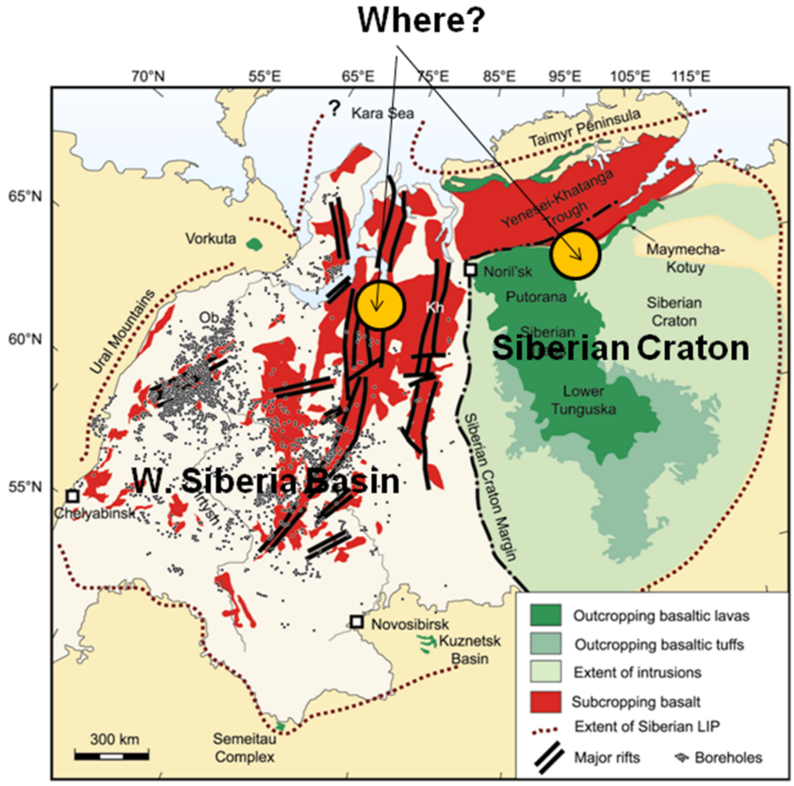

Figure 1: Siberian Traps map [3] with possible location of the plume-head arriving point (solid circle). According to one scenario [1] plume arrived to the thin lithosphere of the West Siberia Basin, Accor-ding to another [2] it arrived close to the margin of thick lithosphere of the Siberian Craton.

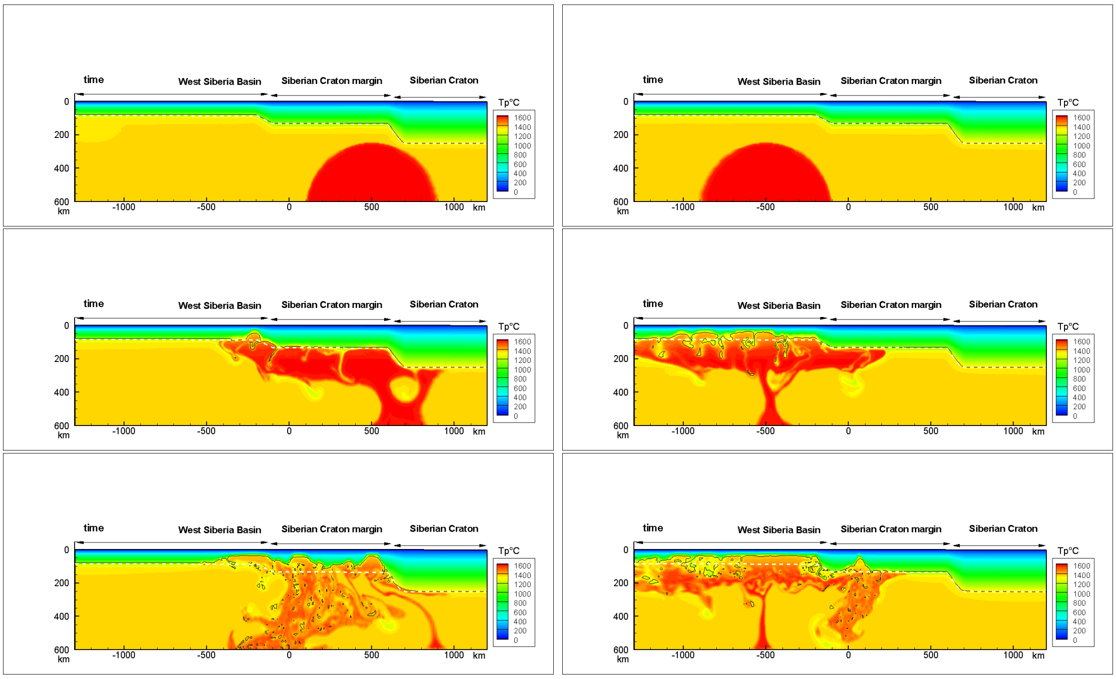

Figure 2: Temperature (potential) snapshots at times 0, 0.25 and 1.0 Myr for the models with plume head beneath Eastern Siberian Craton margin (left column) and beneath West Siberia Basin (right column). Model for the plume beneath Craton predicts about 60% of melts erupted at Craton margin and 40% in West Siberia Basin, while model with plume arrived beneath Basin predicts all melt erupted in the Basin.