New constraints on duration and rate of the Siberian traps volcanism based on a new high detailed paleomagnetic data

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Abstract: The Siberian traps represent one of the largest igneous provinces over the world and numerous researchers link their formation with the greatest mass extinction in the Earth history, which have taken place at the Permian-Triassic boundary. However if the emplacement of the Siberian traps occurred more or less evenly, then, taking into account their volume and duration values, the mean eruption rate can be estimated as 2-5 sq.km/year. This is compatible with the rate of basalts production in the modern middle oceanic ridges and several times less than it was in a range of historical volcanic eruptions. This casts some doubts on the possibility of causal link between the Siberian traps and P-T mass extinction.

However, there are no much reasons to believe that eruption of the traps may have occurred gradually. On the contrary, we can expect that trap emplacement may have taken place in form of volcanic pulses occurred during pretty short time intervals, as it was shown, for example for Deccan traps (Chenet et al. 2008).

To check the existence of such the pulses during the Siberian trap formation and in order to get some time constraints on eruption activity we have undertaken a detailed paleomagnetic study of several important trap volcanic sections located in the Norilsk and Maymecha-Kotuy areas (Northern Siberia). Obtained results indicate that the most if not overwhelming part of volcanic piles of the Norilsk and Maymecha-Kotuy regions has been formed during limited number of volcanic pulses and individual eruptions. In particular, for consolidated Kotuy section our calculations reveal 17 directional groups and 13 individual directions, for Norilsk section – 23 directional groups and 12 individual directions (the technique is described in Chenet et al. 2008). Taking into account rather conservative time constraints this implies that duration of the volcanic activity when the composite Kotuy and Norilsk sections may have been formed do not exceed time interval of order of 10 000 years. This estimation does not include the

quiescence periods, separating volcanic pulses (correspond to directional groups) and individual eruptions.

Our study confirms the occurrence of thick transitional and excursional intervals in sections of the Norilsk region, suggested earlier [Heunemann et al. 2004; Gurevitch et al. 2004]. This observation indicates that at least one quarter of the whole Norilsk region volcanic sequence may have been formed during a relatively short time interval over the time of a reversal of the geomagnetic field, i.e. within several tens of thousands years and even faster. Tracing of the transitional interval through the Kharaelakh, Norilsk and Imangdin troughs implies that more than 1000 cubic km have been erupted during only several volcanic pulses and individual eruptions.

The results obtained in this study allow us to calculate the refined Siberian Permian-Triassic paleomagnetic pole based on data from volcanic flows only. Its coordinates and statistic parameters are following: Plat = 54.2, Plong = 147.2; A95= 4.7, K = 18.6, N = 53.

Our results evidence for geomagnetic field variations at the Permian-Triassic boundary were the same as during the Late Cenozoic. We suggest that the paleosecular variations, recorded in the Kotuy consolidated section, are not sufficiently averaged that may be a consequence of a relatively short (less than 10 000 years) time of formation of this section.

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Keywords: Siberian traps, Permian-Triassic, directional groups, paleomagnetism.

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