Forum Comment

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Field evidence for coal combustion links the 252 Ma Siberian Traps with global carbon disruption

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Elkins-Tanton et al. (2020) assert that they found the first direct evidence that the earliest eruptions in the southern part of the Tunguska magmatic province (Russia) burned large volumes of vegetation and coal. They suggest that the volume and composition of organic matter interacting with magmas may explain the global carbon isotope signal of the global warming that may have significantly driven the end-Permian extinction. While attractive, we argue that this hypothesis suffers several shortcomings. Furthermore, Elkins-Tanton et al.'s results need validation and testing with a precise temporal chronology between the global $\delta^{13}C_{org}$ spike and the organic carbon data from the Permian and Triassic in the Tunguska Basin (TB). Perhaps most troubling is that the authors' study was done without considering the details of the local and regional geology, and this has led to mistakes, misinterpretations, and misrepresentations. How the Elkins-Tanton et al. data have been linked to global $\delta^{13}C_{org}$ content is unclear.

No chronological data were provided by Elkins-Tanton et al. to establish the chronostratigraphic relationships among the samples collected within the different parts of the TB. Essentially it is assumed that all studied samples were modified by basalts during a narrow time window of ~30–35 k.y., correlative to the time of the $\delta^{13}C_{org}$ spike in south China at c.a. 251.94–251.9 Ma in the Meishan section (Burgess et al., 2014). Fortunately, rather detailed geologic maps and GPS coordinates for each sample were provided by Elkins-Tanton et al. When all these samples are plotted on the Russian geologic maps (publicly available at http://www.geolkarta.ru), it turns out that they were collected in five different stratigraphic horizons (Fig. 1, TB1): (1) upper Permian Arydzhan Formation (Maimecha-Kotui), (2) lower Olenekian Bugartic Formation of Nizhnyaya Tunguska, (3) middle-upper Olenekian Korvuchana Formation of Podkamenaya Tunguska, (4) middle Anisian Kharaelakh Formation in the Norilsk region, and (5) middle-upper Anisian Nerjundian Formation of Angara-Ilim. The age of these formations and/or horizons is well defined thanks to comprehensive stratigraphic and paleontological studies in the TB (Kazakov, 2002). Thus, the Elkins-Tanton et al. samples span 9 m.y. (253–244 Ma, i.e., Changhsingian to Anisian) and do not link to the $\delta^{13}C_{org}$ carbon spike found in south China.

According to Burgess and Bowring (2015, their figure 3), nearly the entire basalt succession in the TB is Permian in age (Fig. 1, TB2), and consequently the $\delta^{13}C_{org}$ carbon spike at the end-Permian extinction, in their opinion, occurs near the end of the trap's succession in the TB (Fig. 1, TB2). If the Burgess and Bowring (2015) time model is assumed to be correct, all Elkins-Tanton et al. samples would be late Permian in age.

Generally, in the TB, an unconformity exists between the Permian and Triassic, with a stratigraphic gap spanning some of, or the entire, Lower Triassic (Fig. 1; Kazakov, 2002; Paderin et al., 2016). No massive coal combustion on the surface, as proposed by Elkins-Tanton et al., at the Permian-Triassic transition in the Norilsk region occurs, where the succession is most complete. There is just one unsteady but unique coal "Zametny" (0–2.5 m) in the upper basalts of the upper Permian Ivakin Formation (Paderin et al., 2016). Even this coal that occurs within the basalt succession was not altered. Therefore, its occurrence within the basalts does not support the model proposed by Elkins-Tanton et al. The Ambarnaya formation of the Tunguska Series of Lopingian age contains a couple of thin and non-productive coals (>0.3 m; Cherepovskiy, 2001) and could not be a source for massive coal combustion. In addition, because of the moisture content of coal, the energy of the trap volcanism would not be sufficient to generate coal combustion.

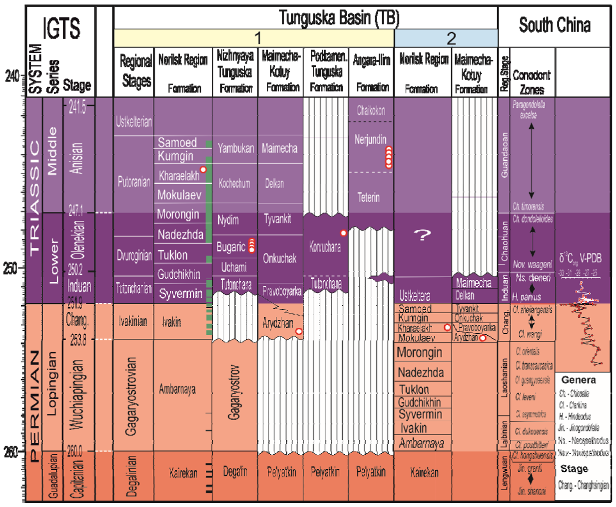

Figure 1. Correlation chart of the Permian-Triassic formations in the Tunguska Basin, Russia and China. (1) Correlation proposed by Kazakov (2002) and Paderin et al. (2016); (2) Correlation according to Burgess and Bowring (2015). Green boxes on the right of the formation succession are basalts and their conventional thickness; black boxes indicate coals and their conventional thickness within the formations. Red rings show the stratigraphic position of Elkins-Tanton et al. (2020) samples in each locality within the TB1 and TB2. Dashed lines: white—correlation according to Kazakov (2002). Distribution and thickness of basalts are according to Paderin et al. (2012); coals are according to Cherepovsky (2001). South China zonation, local scale, and $\delta^{13}C_{org}$ are from Burgess et al. (2014) and Tong et al. (2019).

There are also a few other mistakes in Elkins-Tanton et al.'s paper. For example, in the stratigraphic log (their figure 1) the basalts are shown as Triassic, whereas in a supplementary figure of Elkins-Tanton et al. (2020, their figure S7) it is identified as upper Permian and Triassic; the caption of their figure 2 suggests that "…at the Kaerkan open-pit mine near the town of Talnakh." This open pit occurs near the city of Kaerkan, ~40 km southwest from Talnakh.

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