IS A WHOLE-MANTLE CONVECTION THE KEY TO SOLVING THE TUNGUSKA 1908 PROBLEM ?

Boris R. German (Donetsk, Ukraine - Freiburg, Germany)

EGU General Assembly 2020

INTRODUCTION

On June 30, 1908 at 0:15 (±0.05 min) UT a powerful explosion occurred in the Tunguska basin of Eastern Siberia. It is accepted that a comet or an asteroid exploded exactly over the centre of the 252 Myr-old paleovolcano. This paleovolcano is associated with a mantle plume and the kimberlites fields in Eastern Siberia. However, the puzzle is the absence of space bodies remnants in/on the ground. Therefore, there is no common agreement [1] that a meteorite really existed.

WHOLE–MANTLE CONVECTION via LLSVPs

Day by day a slowly lifting of the earth around the diabase stones was registered in Tasmania from 7 June till 29 June, 1908 [2]. This uplift was dependent from atmospheric temperature variations (from 19° F to 101° F) and terminated in Tasmania as soon as the Tunguska blast took place on the opposite side of the Earth in Siberia on 30 June, 1908 [2-4]. The observations in Tasmania remained a mystery for a long time. Recently it became known [5] that there is the 2000-km Cosgrove hotspot track from Eastern Australia to Tasmania (Fig. 1). In our opinion, the Cosgrove hotspot did not lose its activity fully 9 Ma [5] because (1) the Darwin crater in Tasmania originated about 803 ka years and the large volume of ejected glasses in/around this small crater contradicts to the impact origin [6-8], (2) there were earthquakes in the predicted present-day Cosgrove hotspot location recently detected [5]. Hence, we consider the underground pressure of a mantle plume, i.e., an activation of the Cosgrove hotspot, as a cause of surface uplift in Tasmania from 7 till 30 June, 1908 [3].

Since the African and Pacific LLSVPs, most extensive regions on the core/mantle boundary (CMB), are antipodal (Fig. 3), we attribute their formation to the result long-existing perturbances of subduction lithospheric slabs in the mantle/CMB by antipodal lunar-solar tides.

Mantle plumes are mostly vertically generated above LLSVPs, but they can also be split into branches and tilted [9] because are deflected by background convection currents. Eastern Australia, from where the Cosgrove hotspot track began to move, is adjacent to the area above the western margin of the Pacific LLSVP (Fig. 2). The present-day Cosgrove hotspot is in Tasmania due to the lithosphere thickness beneath Tasmania, and as result of either Cosgrove plume movements or the Australian plate over fixed plume [5]. In turn, the smaller isolated present-day Perm LLSVP Anomaly (Figs. 1-3), identified beneath Eurasia, is proposed as a north-eastern arm of ancient TUZO LLSVP and as a trigger for the Siberian Traps (~ 252 Ma) [Ref. 10: Fig. 1C] with centre in the Tunguska basin (Figs. 1, 2). Moreover, according to flow models [10], the ancient predicted mobile Perm-like anomaly (i.e., the source of the present Perm LLSVP Anomaly) had initial coordinates (~ 100 E, 60 N) [11] close to coordinates of the Tunguska 1908 explosion (~ 101 E, 61 N) [3]. Therefore, we assume that for paths of the mantle plum into the Tunguska basin/paleovolcano in 1908 could be responsible alternatively: (1) quasi-vertical return upwelling flows from nucleation sites of the mobile Perm-like anomaly due to slab remnants of the Mongol-Ochotsk Ocean lithosphere, (2) tilted/splitted paths from the present-day Perm LLSVP Anomaly.

It has been argued that the Earth's hotspots chains may be interconnected [12] because different volcanoes fed by plumes were activated almost simultaneously at the K/T boundary. Indeed, during the Tunguska 1908 event brightest glows were observed over the Eifel volcano and more weak one over the Yellowstone volcano [2]. Therefore, we suppose the link between the Cosgrove hotspot and Tunguska paleovolcano, associated with CMB/mantle perturbations on June 27-30, 1908, and then with the mantle plumes upwelling.

There are reasons to suppose that plumes under the Tunguska basin and Tasmania are linked by a dynamical relationship and that they roots can connect via blobs and the whole-mantle convection in the depth because tomographic models indicate [Ref. 11: Fig. 1B] that both under Tasmania and in the Perm LLSVP Anomaly, present-day estimated mantle temperatures are close to each other at 2677 km depth (Fig. 3). Therefore, we suppose (1) the existence of a common magmatic reservoir of Earth's mantle, associated with LLSVPs, whereby all plums can be interconnected to varying degrees (if so, then since the thermo-chemical energy from this magmatic reservoir was released by the Tunguska paleovolcano explosion on 30 June, 1908, the fluidal pressure of the Cosgrove plume under Tasmania was reduced, resulting in the termination of surface uplift on 30 June, 1908), (2) after the explosion in Siberia, displacements of three contacting - Eurasian-Sundaland-Australian - plates (as a domino effect) [13] blocked further release of the Cosgrove plume conduit (i.e., hot gases) to the surface in Tasmania.

Asteroids/comets, even captured to the Earth's orbit in June, 1908 (if they were, astronomers would report it), could not cause the uplift of surface in Tasmania. Thus, impact hypothesis for the Tunguska event can be excluded. In that case, what are the causes of the Tunguska explosion?

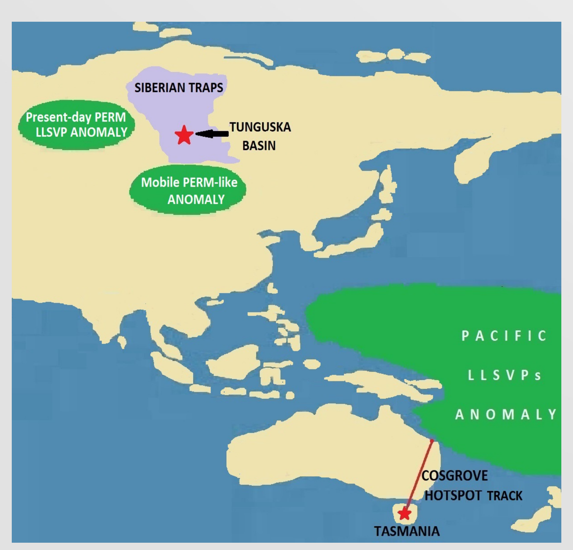

Fig. 1. *Scheme for a location of both the Cosgrove hotspot (near an area above the Pacific LLSVP Anomaly) and the Tunguska Basin (near an area above the present-day/past mobile Perm LLSVPs anomalies).*

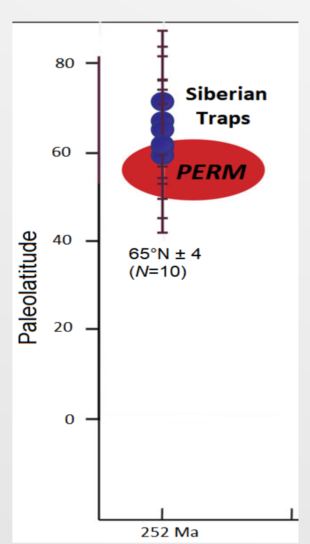

Fig. 2. *The PERM LLSVP Anomaly as trigger for the 252-Ma Siberian Traps with centre in the Tunguska Basin. Adapted from ref. [10]. Credit: Torsvik, T. (The Creative Commons Attribution 4.0 International License).*

SOURCES of the TUNGUSKA EVENT

(1) The hypothesis of mascon (i.e., mass concentration) formation during the Allais effect of solar eclipse.

During the solar eclipse on June 30, 1954, the Allais effect, i.e., changes in azimuth angle of the paraconical pendulum, or possibly a reduction in the Earth's gravitation instead of its increase though the Moon shielded a Sun's gravitation, was registered [14]. A later, analysis of Eötvös experiments led to the hypothesis of the existence of a repulsive gravity-like 'fifth' fundamental force in the nature [15]. In connection with the Allais effect a formation of the mascon of 10^{11} kg inside an area of lunar umbra/penumbra at the altitude of 8.5 km during solar eclipses has been already assumed [16]. Here is considered gravitational effects of an increased density air mass spot due to cooling of the atmosphere. Using same arguments we suppose that such mascon could form in the solar eclipse area on 28 June, 1908 and has been to reach Siberia on 30 June, 1908 [17]. Our hypothesis has a surprising correlation with results of the recalculation for seismic data [18] where it has been shown that the Tunguska "space body" had a weight of 10^{11} kg, and that explosion has occurred exactly at a height of 8.5 km.

(2) The anomalous lunar-solar activity during the Tunguska 1908 event.

The inversion of speeds for polarization's points Arago/Babinet has been noted since 10 May, 1907 [3]. For one day before the Tunguska 1908 explosion, the displacement of polarization minima were registered. It had a connection with vortex structures on the Sun during the years 1907-1908 [17]. It has been proven that the interplanetary magnetic field (IMF) interacts with the geomagnetic field and causes it to oscillate in resonance with solar modes waves [19, 20]. The tangential component of IMF has no compensation, as IMF possesses dily variations with a local peak of intensity at 18 h local time. This time coincides with the beginning of Pc5 geomagnetic pulsations with the period of 3 minutes (ULF) registered at Kiel on 27-30 June, 1908 [21]. Therefore, these oscillations correlated with the 3-minutes so-called 'acoustic halo' of stellar (solar) flares [2, 22] and associated with magnetospheric substorms. After the Tunguska explosion on 30 June, 1908, the Irkutsk observatory registered a magnetic substorm lasting ~ 5 hours [3]. Note, the outer magnetospheric radiation belt approaches to the Earth's surface about of 60°-latitude, i.e., about of the latitude of the Tunguska 1908 explosion (and, in addition, about of the Perm/Perm-like LLSVP anomalies latitude).

An anomalous gravitation tide in the Tunguska area happened [23] probably due to the discrepancy in the secular evolution of the lunar longitude, i.e., of the big bump which was observed in the 1900-1920 [24]. By assumption of R. Dicke [25], the Sun possibly emits scalar waves in a long-range, i.e., zero-mass chargeless, scalar fields, and the discrepancy in the secular evolution of the Moon longitude in the beginning of the 20th century was possibly caused by the Moon passage through a stream of scalar waves. According to this hypothesis the variations in earthquake rates is interpreted in terms of changes of the gravitation constant which (changes) could be caused by passaging scalar waves [25]. A variation of gravitational constant with a period of a sidereal year was assumed [26]. The tilt of the geomagnetic dipole to the IMF determines the point of summer solstice. Indeed, before the Tunguska phenomenon, on 22 June, 1908, optical anomalies in Europe sharply increased [17, 19].

Another possibility for solution of the Moon longitude discrepancy is change of the Earth's rotation axis in spatial position. The Earth's moment of inertia is result from the density anomalies in the Earth's interior [27]. It was proposed [28] that geomagnetic secular variations exert impulsive torques on the mantle and that these would perturb both the l.o.d. (length of day) and Chandler wobbles, or polar motion. The Sun/Moon gravitation causes a precession of the Earth's axis and, therefore, torques in the core and mantle. This promotes asymmetric convection in the outer liquid core. Possibly reasons for fluctuations of l.o.d. (and for the Earth's magnetic field) could be found in the currents in a fluid core (the problem of the Earth's magnetic field origin has not yet been finally solved).

It is known that under Eastern Siberia a pole of the Earth's quadrupole momentum is located [17]. A superimposition of a quadrupole field on a main dipole field of the Earth provides an explanation of Earth's magnetic field reversals [2, 17]. In Eastern Siberia an agonic line (i.e., the line of zero declination) has an anomaly: the western declination is observed instead of the eastern one. This line turned clockwise towards the sublatitude orientations especially in the Irkutsk-Krasnojarsk region from 1901 till 1909 [17].

It was suggested [27] that hotspots moving in each hemisphere correlate with episodes in true polar wander (TPW) and are probably results of the low mantle convection. During the Tunguska 1908 phenomenon period from June 2 to July 14, 1908, a strong change in TPW was recorded [17]. Probably susceptibility of an Eötvös force to change of gravitation by an amplitude of 20 mGal explains an effect of polar motion [29]. An amplitude of 20 mGal accords well with a magnitude of lunisolar tidal forces [30]. In our opinion, this tidal force could increase pressure on the CMB/mantle and thus as a result of heating and aminerals differentiation there was mantle plume activations under Siberia/Tasmania/etc. in 1908. Thus, we suppose that a change in the Earth's rotation (precession/inertia) due a gravitation of both the Sun and the Moon during/after the solar eclipse/flares (also, possibly the Allais effect and mascon formation) in June, 1908 was led to the convection perturbations in the core/CMB/mantle, upwelling of mantle plumes and then the explosion of paleovolcano in the Tunguska basin.

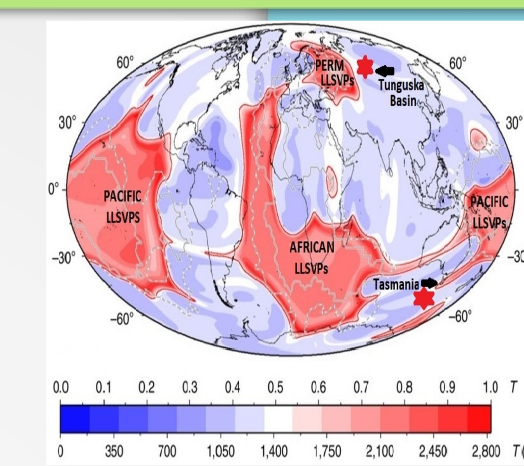

Fig. 3. *The lower mantle structure derived from a seismic tomography and mantle flow models. Adapted from ref. [11]. Credit: Flament, N. (The Creative Commons Attribution 4.0 International License).*

CONCLUSIONS

(1) Since the African and Pacific LLSVPs are antipodal, we attribute their formation to the result of long-term perturbances of subduction lithospheric slabs in the mantle/CMB by antipodal lunar-solar tides. (2) We assume the existence of a common magmatic reservoir of Earth's mantle, associated probably with LLSVPs, whereby mantle plumes can be interconnected. (3) We suppose that due to the gravity of both the Sun and Moon, changes in Earth rotation, and possibly the formation of maskon during/after the solar eclipse/flares in June 1908, led to convection disturbances in the core/CMB/mantle, the upwelling of mantle plumes, and then the explosion of paleovolcano in the Tunguska basin. (4) The new data, connected with non-typical registrations in Tasmania in the period of the Tunguska 1908 event, provide a highly probable solution to the problem of the previous century.

ACKNOWLEDGEMENTS

The author thanks Nicolas Flament and Trond Helge Torsvik for the credits.

REFERENCES

[1] Kundt, W. (2001). The 1908 Tunguska Catastrophe: an alternative explanation, Current Science, V. 81(4), p. 399.
[2] Scott, H. (1908) The letter to the editor on 20. August, 1908, Nature, V. 78, N. 2025, p. 376.
[3] German, B. (2019) Crisis of the meteorite paradigm: craters, tektites, the Tunguska event, ISBN 9783981952605 (in Russian), 164 p.; ISBN 9783981952612 (in English), 136 p.
[4] German, B. (2007) Die Lösung des Tunguska-1908 Problems, ISBN 9783000227394, Marburg-Freiburg, 52 p.
[5] Davies, D. et al. (2015) Lithospheric controls on magma composition along Earth's longest hotspot track, Nature, V. 525, 511.
[6] Lo, C. et al. (2002) Laser Fusion Ar-40/Ar-39 ages of Darwin impact glasses, MPS, V. 37, p. 1555.
[7] Howard, K.& Haines, P. (2003) Distribution and abundance of Darwin crater glass, Conf. Large Meteorite Impacts, Nördlingen (Ger.).
[8] Grieve, R .& Cintala, M. (1992) An analysis of different. impact melt-crater scaling, Meteoritics, V. 27, 526.
[9] Tsekhmistrenko, M. et al. (2019) Deep mantle upwelling under Réunion hotspot and the western Indian Ocean from P- and S-wave tomography, 21st EGU Assembly, Vienna, Austria, Proceedings id. 9447.
[10] Torsvik, T. & Domeier, M. (2017) Numerical modelling of the PERM anomaly and the Emeishan large igneous province, Nature Communications, V. 8, DOI: 10.1038/s41467-017-00125-2.
[11] Flament, N. et al. (2017) Origin and evolution of the deep thermochemical structure beneath Eurasia, Nature Communications, V. 8, DOI: 10.1038/ncomms 14164.
[12] Courtillot, V. et al. (1990) Global Catastrophes in Earth History, ISBN 9780813722474, Geol. Soc. of Amer., Spec. Paper 247, p. 406.
[13] DeMetz et al. (2010) Geologically current plate motions, Geophys. J. Int., V. 181, 1-80, doi: 10.1111/j.1365-246X.2009.04491.x.
[14] Allais, M. (1957) Movement of a pendulum during a total solar eclipse on June 30, 1954, Works Acad. Sci., V. 245, 4.
[15] Fischbach, E. et al. (1988) Long-range forces and the Eötvös experiment, Annals of Physics, 182, 1, pp. 1-89.
[16] Van Flandern, T. & Yang, X. (2003) Allais gravity and pendulum effects during solar eclipses explained, Phys. Rev., D 67, 022002.
[17] German, B. (2009) Geomagnetic pulsations and Tunguska-1908 phenomenon, Proceedings of the 2nd Swarm Int. Sci. Meeting, ESA, Potsdam, Germany, pp. 34-42 (https://www.researchgate.net/publication/338987308).
[18] Ben-Menachem, A. (1975) Source parameters of the Siberian explosion of June 30, 1908, Phys. Earth Planet. Int., V. 11 (1), 1-35.
[19] German, B. (2009) Tunguska-1908 explosion and global warming, Proc. ESA Atmosp. Conf., Spain, V. SP-676 (CD-ROM), pp. 18-26.
[20] Thomson, D. (2008) Coherence between iMF field at ACE and geomagnetic observatory data, 37th COSPAR, Canada.
[21] Weber, L. (1908) The report to the editor, Astronomische Nachrichten, V. 178, p. 239.
[22] German, B. (2012) Is the Tunguska explosion connected to the Sun? Paneth Colloquium, Nördlingen, Germany.
[23] German, B. (2009) Lunar tide had caused the Tunguska phenomenon, EPSC, Potsdam, Germany, V. 4, p. 680.
[24] Munk, W., Macdonald G. (1960) The rotation of the earth: a geophysical discussion, Cambridge: Cambridge Uni, 1st. Ed., p. 180.
[25] Dicke, R. (1964) Possible Effects on the Solar System of scalar Waves if they exist, in 'Gravitation and Relativy', N. Y., pp. 241-259.
[26] Dionysiou, D. et al. (1993) Newtonian and Post-Newtonian tidal theory - Variable G, Earth, Moon, and Planets, V. 60, 2, pp. 127-140.
[27] Courtillot, V. et al. (2003) The emergence of primary hotspots as LPI in the last 300 Ma, EGS-AGU Assembly, Nice, France, id 6938.
[28] Runcorn, S. (1972) Evidence on the deeper planetary interiors, Phys. Earth Planet. Int., V. 6, p. 99.
[29] Jeffrey, H. (1976) The Earth, Cambridge: Cambridge Uni, p. 56.
[30] Melchior, P. (1983) The tides of the planet Earth, Oxford: Pergamon, p. 64.