Scientific Research Publishing

International Journal of Geosciences, 2022, 13, 349-360
https://www.scirp.org/journal/ijg
ISSN Online: 2156-8367
ISSN Print: 2156-8359

The Hawaiian Volcanic Hotspot in View of Globally Active Geological, Meteorological and Cosmic Processes

Heinz-Jürgen Brink

Hindenburgstraße 39, Hannover, Germany
Email: 0511814674-0001@t-online.de

How to cite this paper: Brink, H.-J. (2022) The Hawaiian Volcanic Hotspot in View of Globally Active Geological, Meteorological and Cosmic Processes. *International Journal of Geosciences*, **13**, 349-360.
https://doi.org/10.4236/ijg.2022.135019

Received: April 21, 2022
Accepted: May 27, 2022
Published: May 30, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/

Open Access

Abstract

Some volcanic events including flood basalt eruptions and hotspots on earth may strongly be related to (chaotic) Asteroid impacts and (more periodic) near solar system Supernovae explosions. Impacts may define some of the eruption sites and Supernovae, their intensity. The accompanied heat event can lead to a sedimentary basin on top, where a metamorphic process in the lower crust provides a depression at the surface of the earth due to rock volume reduction by water release. The definitely alternating heat event may generally be fixed to the original geographically defined impact site and can certainly last hundreds of Million years. Plate tectonics distribute the relicts of the (tornado like spiraling upwards?) volcanism across the globe. The Hawaiian volcanic hotspot and its possible origin in Northern Australia beginning with the eruptions of Cambrian Antrim flood basalts and a speculative initiating earlier Asteroid impact may act as a further example. Similar to the footprints of astronomical events on climate and life on earth geological processes like volcanism, metamorphism within the earth's crust and subsequent sedimentary basin development may also be marks of some cosmic influence.

Keywords

Hawaiian Volcanic Hotspot, Antrim Flood Basalt, Asteroid Impact, Tornado, Shiprock Volcanic Core, Salt Diapir Rotation, Supernovae, Neutrinos, Eocene

1. Introduction

It has already been demonstrated [1] that traces of present day hotspot volcanoes (presumably ± fixed) appear to be related to the locations of large ancient volcanic eruptions like flood basalt extrusions and to the origin of sedimentary basins that are developed in course of metamorphic reactions of the lower crust

due to rock density increase and subsequent volume decrease forced by significant thermal anomalies. Examples are 1) the Tibesti Hotspot in Northern Africa and its trace passing the evolving North German Basin in Early Permian and the Russian Timan-Pechora Basin in the Devonian, both with intensive initial volcanic activity at their bases; 2) the Permo-Triassic Siberian Traps and the adjacent Siberian Basin; and 3) the Tertiary Ethiopian Afar Flood Basalts and the East African Rift Hotspot (**Figure 1**).

It is also demonstrated [2] that large Asteroids (crater Ø > 20 km) (Earth Impact Database, http://www.unb.ca/passc/ImpactDatabase/) may have initiated the development of mantle plumes 10 - 20 Million years after the impacts, which are quite often documented by volcanic hotspots as their earth's surface expression close to the original impact sites (**Figure 2**). Impacts prepared the sites by fracturing the lithosphere and triggered or enhanced the development of mantle plumes arising especially from the core-mantle boundary. Examples are the Tristan, Kerguelen, New England, Canary Islands, and Hoggar Hotspots and the related Mesozoic impacts at plate tectonically corrected locations.

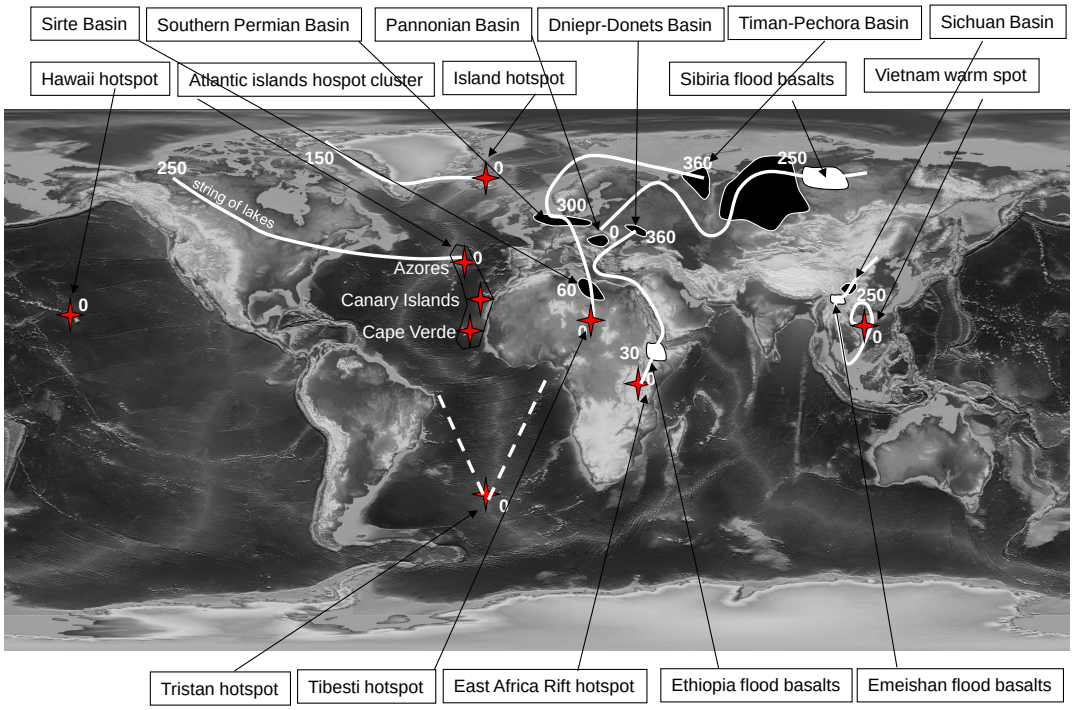


Figure 1. Selected warm- and hotspot positions (red stars) and their projected tracks (curved lines) or postulated relationships (dashed lines), related sedimentary basins (black) and related flood basalt areas (white). The origin of some hydrocarbon bearing sedimentary basins of the world can perfectly be linked to the effect of thermal anomalies, which are either periodically or episodically active and are located presumably at stable positions within the Earth mantle. The lithospheric plates migrated during their continental drift above those assumingly ± stable locations. Volcanism and magmatism during the initial phase of the basin development, thermal metamorphism within the lower crust and the interaction with isostatic subsidence are processes, which accompanied the evolution of many sedimentary basins. The West Siberia Basin, the Sichuan Basin, the Dniepr-Donets Basin, and the North German Basin as part of the Southern Permian Basin are impressive examples as well as the Pannonian Basin in Europe, the Sirte Basin in Northern Africa and the Sichuan Basin in China. The locations of the Great Lakes and further smaller Canadian lakes in North America may also be related to a fixed hotspot (Azores?). Additionally, the hot/warm spots of Hawaii, Island and Vietnam are shown as well. After [1].

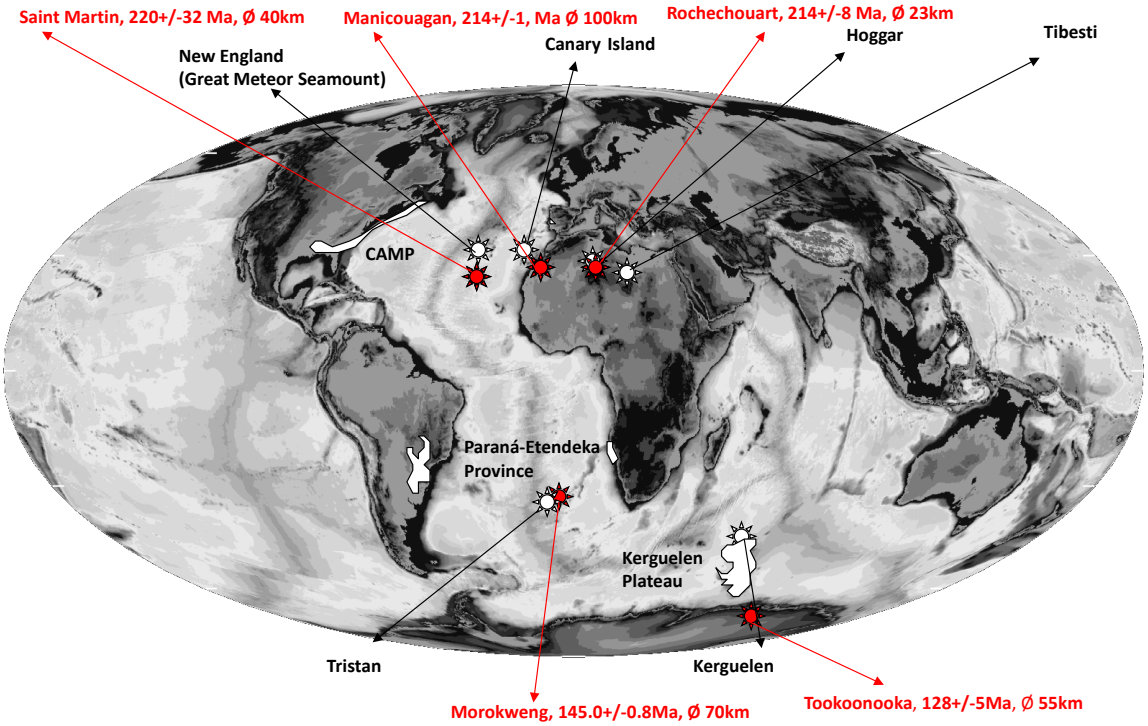


Figure 2. Selected volcanic hot spots (white stars) and impacts (red stars, at continental drift corrected geographical positions) [2]. Background map: Modified present day Earth altimetry and bathymetry at 15 minute horizontal resolution. Derived from the National Geophysical Data Center's Terrain Base, Digital Terrain Model (v1.0). [http://www.ngdc.noaa.gov/seg/fliers/se-1104.shtml TerrainBase Digi]. Date: 7 March 2007. Source: English Wikipedia. Author: Plumbago. After [2].

1) The Tristan mantle plume in the southern Atlantic Ocean (including the Paraná-Etendeka flood basalts of South America and southern Africa and the present day hot spot) may have been triggered by the Morokweng impact (~145 Ma, Ø 70 km) in present day South Africa (time delay to surface expression: 14 Myr). The rifting event of the southern Atlantic between South America and Africa may have been prepared by a proto-Tristan hotspot that acted already like a cutting torch during the northward migration of Pangea and Gondwana, respectively [2]. The very similar delay between impact time and first eruptions of flood basalt as observed in the Kerguelen and CAMP areas is striking,

2) The Kerguelen mantle plume in the southern Indian Ocean (including the flood basalts of the Kerguelen Plateau and the present day hot spot) may have been triggered by the Tookoonooka impact (~128 Ma, Ø 55 km) in present day Australia (time delay to surface expression: 12 Myr).

3) The Canary Island hot spot in the central Atlantic Ocean and some eruptions of the flood basalts of the northern CAMP may have been triggered by the Manicouagan impact (~214 Ma, Ø 100 km) in present day eastern Canada (time delay to surface expression: 14 Myr). The adjacent site of the New England (Great Meteor Seamount) hot spot in the central Atlantic Ocean may has been

prepared by the Saint Martin impact located in present day central Canada (~220 Ma, Ø 40 km)

4) The site of the Hoggar hot spot in northern Africa may have been triggered by the Rochechouart impact located in present day France (~214 Ma, Ø 23 km). The linear cluster of the last 3 craters with a very similar impact time (203 - 224 Ma ago (Late Triassic)) suggests that one asteroid could get fragmented into at least 3 pieces. The orientation of the cluster points to a roughly E-W approach of the bolide. The largest fragment hit the Manicouagan site (~214 Ma, Ø 100 km) close to the position, where later the North Atlantic opened. Times and locations make it very unlikely that no relationship between impacts and volcanism exists.

The question arises now, does the globally most famous hotspot Hawaii may own a similar long lasting history, eventually stabilized through a singular vertical energy transfer like other "comparable" punctual events on earth did or do? This article will be the structured attempt to use the story behind the geology of Hawaii and its possible relation to Supernovae processes within the Milky Way galaxy as analysis tool with global importance.

2. History of the Hawaiian Volcanic Hotspot

The Hawaiian Hotspot in the center of the Pacific Ocean is the surface expression of a (presumably ± fixed) remarkable mantle plume [3] [4]. The overriding tectonic Pacific Plate witnesses its long lasting existence since over 80 Million years by the development of a submerged volcanic chain (Hawaiian and Emperor chains) above the sea bottom (**Figure 3**).

This chain looks like the track of a tornado generating atmospheric Supercell through the Midwest of the United States (**Figure 4** (Supercell track) and **Figure 5** (tornado example)).

Similar to a tornado with its 3-dimensional rotational transfer of energy vertically upwards the hotspot volcano may rotationally screw up heated rocks – in this case definitely very slowly - in a force reducing spiral towards the surface of the earth. Impacts may have prepared a fractured pathway inside the earth's crust and mantle for the (spiraling) ascent of molten volcanic rocks. Flight observations above the core of the "Shiprock" volcano in New Mexico/USA may show an example and could therefore support this assumption (**Figure 6**) [7].

An analogous spiraling behavior of rocks able to flow in a long run has also been documented for salt diapirs in Northern Germany [8]. The secondary rim synclines of many salt diapirs, aging from Lower/Middle Triassic (s+m) to Tertiary (tt)/Pliocene (pl), rotate with different speed clockwise or counter clockwise around the developing salt plug, probably governed by the shearing effect of left or right lateral strike-slip faulting (**Figure 7**).

The rotation of secondary rim synclines suggests a comparable rotation of the salt within the diapirs. It is therefore quite conceivable that horizontal cross-sections through some North German salt diapirs may show a pattern similar to that of the Grand Saline salt dome in Texas, whose internal structure seems to consist of swirling salt (**Figure 8**).

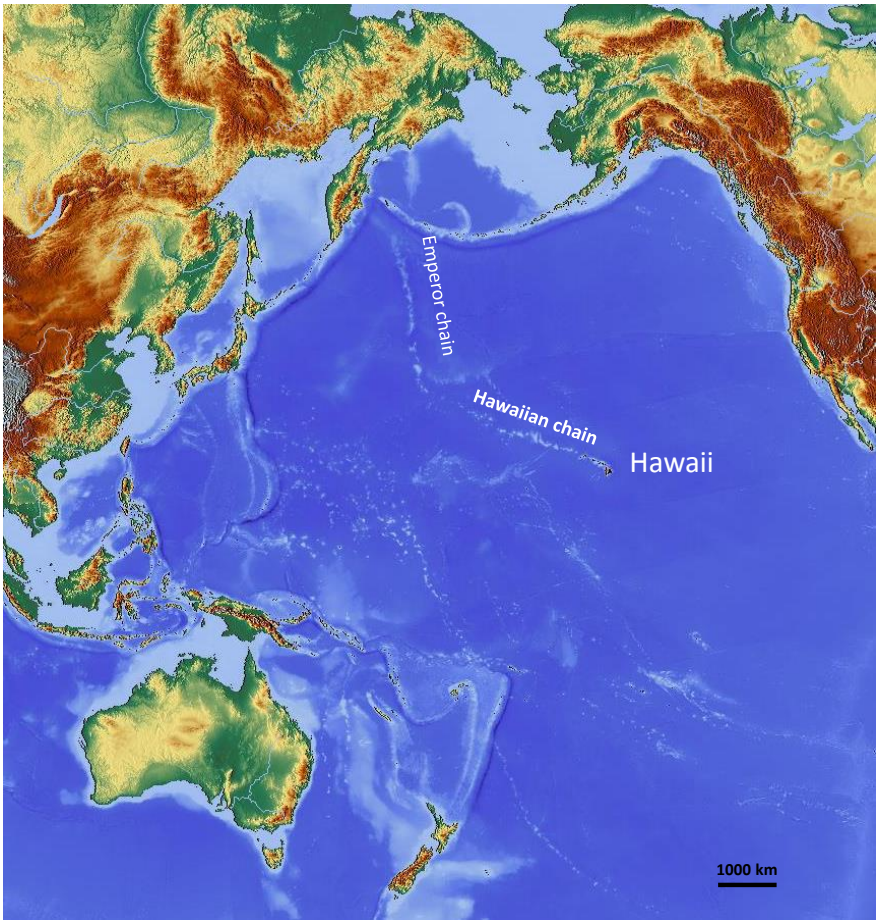
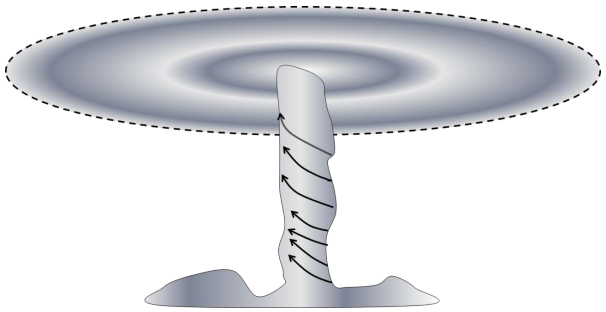


Figure 3. "Linear" trace(s) of the Hawaiian Volcanic Hotspot [4] (https://maps-for-free.com/). (scale bar depending on latitude, for rough estimation only (map projection!))

Figure 4. "Linear" trace of a Tornado generating Supercell [5] https://www.weather.gov/crh/dec112021.

(a) Simla, Colorado. © James Smart [6], info@jamessmart.com.au Landscape & Travel Photographer https://www.jamessmart.com.au



(b)

Figure 5. Photography (a) and Sketch (b) of "DIRT": Jaw-dropping, rare anti-cyclonic tornado tracks in open farm land narrowly missing a home near Simla, Colorado. James Smart©/National Geographic 2015 Photo Contest.

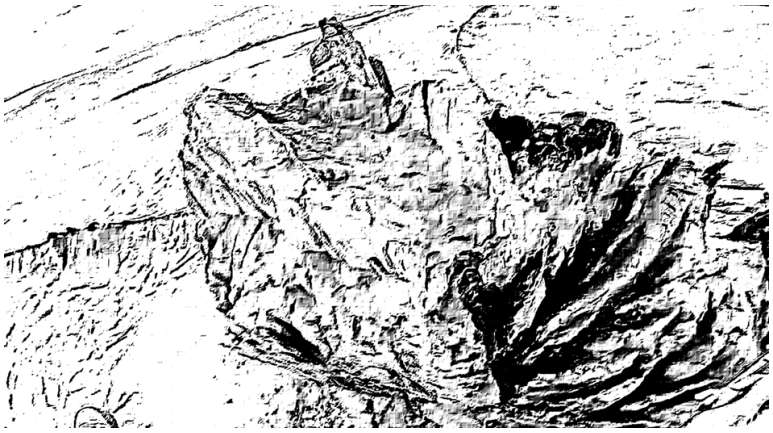


Figure 6. Example of an upwards spiraling Volcanic Core (Shiprock, NM), stylized screenshot from a breathtaking YouTube-video https://www.youtube.com/watch?v=URSZslRsikQ&t=2s "Flying over a 27 million year old volcanic core!!", ©Tucker Gott (2018) [7]. Published comment by one member of the YouTube community: "I'm Navajo and I actually grew up on the reservation south of there. I always wondered what it looked like from the top, Navajo legend says shiprock is the remains of a giant bird that brought the Navajo people to the area. I thought it was really cool that you found a giant bird at the top."

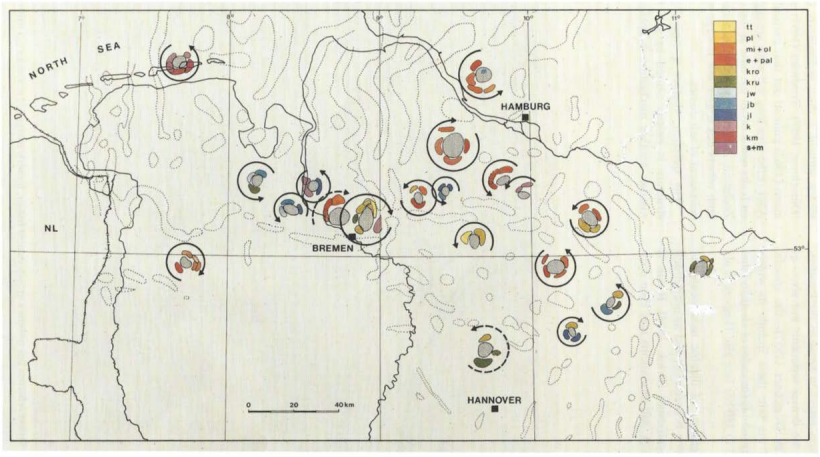


Figure 7. Rotation of secondary rim synclines of extensively distributed Northwestern German Salt Diapirs, probably governed by the shearing effect of left or right lateral wrench faults of different ages and directions [8].

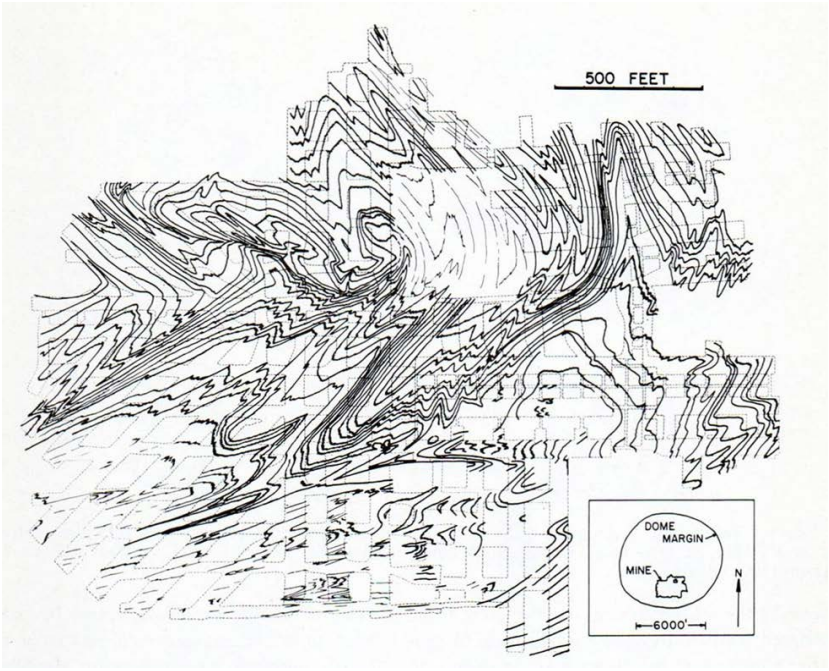


Figure 8. Interpretation of salt structure, Morton Salt Co. mine, Grand Saline salt dome. Location of mine within dome at the mine level is shown in inset map, lower right [9].

Going back in time much earlier than 80 Million years ago, present day Northern Australia - plate tectonically reconstructed [10] [11] - was according to the mentioned references probably lying close to the Hawaiian mantle plume during the Mid Cambrian period about 510 Million years ago (**Figure 9**). This was the time when flood basalts erupted in the Antrim area, possibly indicating the very early presence of the mantle plume that is currently still active below the Hawaiian Islands. Since this coincidence is currently purely hypothetical, following options may exist:

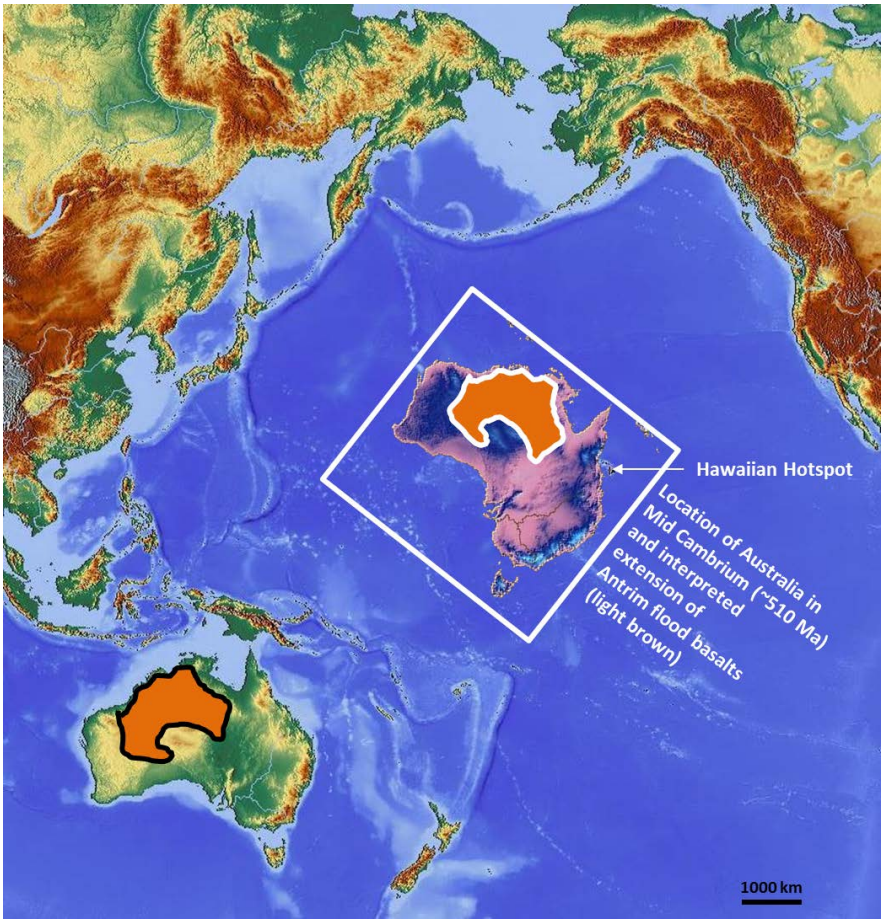


Figure 9. Locations of Australia currently and 510 Million years ago (Antrim flood basalt eruption in Mid Cambrium) close to the Hawaiian volcanic hotspot. (scale bar depending on latitude, for rough estimation only (map projection!))

1) The misfit between the two locations is due to a suboptimal reconstruction of the presented Cambrian plate history of Australia.

2) The Hawaiian hotspot moved about 1500 km towards the east in course of the time and appears therefore unfixed. The moving rate would be on average about 1500 km/500Million years = 3 km/my = 3 mm/y. Different directions and different moving rates in different short time intervals may have occurred and may further occur.

3) The close neighborhood of both locations, the ones of the Antrim flood basalt of Mid Cambrian times and of the present day Hawaiian hotspot, is just by chance.

4) If a dramatic change in plate tectonic reconstructions has to be applied due to verified updated paleomagnetic or other supporting information, the required vicinity may not exist anymore.

It is still questionable, whether a large Asteroid impact of the required age (about 530 - 520 Million years) occurred in close vicinity to the flood basalt location. Possibly it is still hidden below the extended Antrim Kalkarindji flood basalt layer [12] (**Figure 9**) or it has been completely eroded since the Paleozoic era or it is otherwise covered by younger sediments.

3. Supernovae vs. Volcanic Eruptions

Besides impacting Asteroids as cosmic sources, which have a significant geological effect on earth, further galactic processes may have influenced the earth's body [13] [14] as well. In addition to their influence on climate and life on earth through cosmic rays, near solar system Supernovae produce a very large amount of neutrinos, which speculatively could heat up the interior of the earth by a significant amount (has still to be independently approved!). This enhances hypothetically the general volcanic activity, not only on earth but also contemporaneously on other planets and moons of the solar system as observed, linking geologic processes on earth, including the history of the Hawaiian Islands, to properties of the Milky Way with its spiral arms and their related time and space dependent Supernovae distribution. The Hawaiian and Emperor volcanic chain is part of the global pulsations of intraplate magmatism through the Cenozoic [3]. The global eruption dates coincide remarkably (including minor errors in the Million years range, optically estimated to roughly 80%) with the ages of near solar system White Dwarfs [15] that are assumed to be remnants of Supernovae explosions, which occurred along the solar system path through the effective spiral arm (**Figure 10**). The highest peak at about 37± Million years around the end of the Eocene points to a very close Supernova explosion at that time, should its rotational movement around the galactic center being similar to that of the solar system. Since the extinction rate is significantly high at the Eocene-Oligocene transition, the life on earth may have been dramatically affected by the cosmic rays of this very close Supernova. "The Supernova SN1940B (NGC4725 posterior/IIP) exploded at about 38 Ma in the Bartonian period of Eocene. At the same time, the Gould Belt in which our solar system was located had many bright stars appearing" (This information has been provided by ShouCheng-Wu (2022) in a personal note). Surprisingly, this Supernova does apparently not correlate with enhanced volcanic activity on earth. The reason for that remains an open question. Only one significant Galapagos eruption took place around that time. Some minor misfits may indicate that further forces and conditions are being involved, which have complexly interfered with the suggested external heat source, or that some age determinations of the two time series do not represent the correct values and that they should be shifted along the time axis accordingly. However, 1 - 2 Million years later at ~36 Ma ago the Popigai (Russia's Crater of Diamonds) and Chesapeake Bay (USA, "inverted sombrero" crater) impactors hit the earth and caused 90 - 100 km large craters [16], [17]. This multi-type asteroid shower may have been triggered by changes of planetary orbital elements, possibly caused by the explosion of the nearby Supernova. Asteroids in a region of the asteroid belt may have been promptly perturbed into orbital resonances. This led to an increase in small to medium-sized collisional breakup events over a 2 - 5 Ma period. This would illuminate the coinciding supply of excess dust and asteroids to the inner solar system. Independent indications for this scenario are the common cosmic-ray exposure ages in the

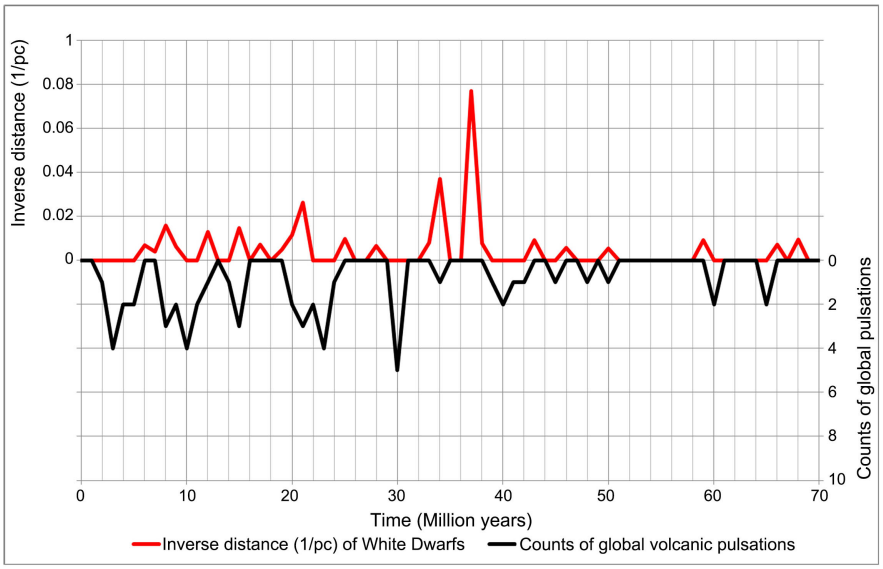


Figure 10. Distribution of near solar system White Dwarfs as assumed remnants of Supernovae during the last 70 My, calibrated by their distance [14] vs. counts of volcanic pulsations [3].

range of ca. 33 - 40 Ma. At least five impact structures with late Eocene ages are known. Instabilities in the climate at that time are recorded additionally to the high extinction rate, and a connection with the Supernova explosion and the (subsequent?) impact events is likely. Both impacts don't show any signs of initiated volcanism within the following 10 - 20 Million years as some other impacts apparently do (the possible "asteroid shower" of Manicouagan, Saint Martin and Rochechouart impacts at ~214 Ma ago as mentioned above).

4. Conclusion

A selected number of volcanic events on earth may hypothetically show a close relation to an external heat flux by the changing activity level of Supernovae within the spiral arms of the Milky Way and to the rather chaotic Asteroid impact history. The impacts may have the potential to produce the sites of mantle plumes with their volcanic events by fracturing the earth's crust and mantle, the Supernovae speculatively the enhancement of melting processes. The lifespan of the plumes is long and can last hundreds of Million years. In this time, plate tectonics distribute the relicts of the volcanic events across the globe and connect them among others to sedimentary basin developments. An extraordinary example is the Hawaiian volcanic hotspot and its relation to Australia with its Cambrian Antrim flood basalts and vice versa. However, different approaches and improved datasets may have the potential to finally verify or falsify the presented ideas in future.

Acknowledgements

The author would like to thank James Smart, Australia, for the release of his already in print and online widely distributed outstanding and award winning

photography of a tornado near Simla/Colorado in 2015 and Tucker Gott, USA, for his decision not to object the use of a stylized screenshot from his 2018 breathtaking YouTube-video "Flying over a 27 million year old volcanic core!!". Further he would like to acknowledge Rui Zhang's, China (张瑞), valuable preliminary review and the final suggestions of anonymous reviewers.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Brink, H.J. (2009) Mantle Plumes and the Metamorphism of the Lower Crust and Their Influence on Basin Evolution. *Marine and Petroleum Geology*, **26**, 606-614. https://doi.org/10.1016/j.marpetgeo.2009.02.002

[2] Brink, H.J. (2012) Flood Basalts, Mantle Plumes and Asteroid Impacts. In: West, J.P., Ed., *Basalt*: *Types*, *Petrology and Uses*, Nova Science Publishers, Inc., Hauppauge, NY, 1-32.

[3] Mjelde, R., Wessel, P. and Müller, R.D. (2010) Global Pulsations of Intraplate Magmatism through the Cenozoic. *Lithosphere*, **2**, 361-376. https://doi.org/10.1130/L107.1

[4] Maps for Free (2022). https://maps-for-free.com/

[5] National Weather Service (2021) NWS Storm Damage Summaries. https://www.weather.gov/crh/dec112021

[6] James Smart Photography (2015) Jaw-Dropping, Rare Anti-Cyclonic Tornado Tracks in Open Farm Land Narrowly Missing a Home near Simla, Colorado. James Smart©/ National Geographic 2015 Photo Contest. https://www.jamessmart.com.au

[7] Gott, T. (2018) Flying over a 27 Million Year Old Volcanic Core!!! YouTube. https://www.youtube.com/watch?v=URSZslRsikQ&t=2s

[8] Brink, H.J., Dürschner, H. and Trappe, H. (1992) Some Aspects of the Late- and Post-Variscan Development of the NW-German Basin. *Tectonophysics*, **207**, 65-95. https://doi.org/10.1016/0040-1951(92)90472-I

[9] Muehlberger, W.R. and Clabaugh, P.S. (1968) Internal Structure and Petrofrabics of Gulf Coast Salt Domes, in Diapirism and Diapirs, Memoir 8. The American Association of Petroleum Geologists (AAPG), Tulsa, 90-98.

[10] Scotese, C.R. (1994) Continental Drift. 6th Edition, PALEOMAP Project, University of Texas, Arlington.

[11] Golonka, J. (2000) Cambrian-Neogene Plate Tectonic Maps, 1-125. Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków. http://www.dinodata.net

[12] Claoué-Long, J. and Hoatson, D. (2010) Large Igneous Provinces Commission, International Association of Volcanology and Chemistry of the Earth's Interior, October 2010 LIP of the Month, Australian LIPs and the Australian Precambrian 'Barcode'. Geoscience Australia, Canberra. http://www.largeigneousprovinces.org/

[13] Brink, H.J. (2015) Periodic Signals of the Milky Way Concealed in Terrestrial Sedimentary Basin Fills and in Planetary Magmatism? *International Journal of Geosciences*, **6**, 831-845. https://doi.org/10.4236/ijg.2015.68067

[14] Brink, H.J. (2019) Do Near-Solar-System Supernovae Enhance Volcanic Activities

on Earth and Neighbouring Planets on Their Paths through the Spiral Arms of the Milky Way, and What Might Be the Consequences for Estimations of Earth's History and Predictions for Its Future? *International Journal of Geosciences*, **10**, 563-575. https://doi.org/10.4236/ijg.2019.105032

[15] Zhao, J.K., Luo, A.L., Oswalt, T.D. and Zhao, G. (2013) 70 DA White Dwarfs Identified in Lamost Pilot Study. *The Astronomical Journal*, **145**, 169-178. https://doi.org/10.1088/0004-6256/145/6/169

[16] Koeberl, C. (2009) Late Eocene Impact Craters and Impactoclastic Layers—An Overview. *Special Paper of the Geological Society of America*, **452**, 17-26. https://doi.org/10.1130/2009.2452(02)

[17] Schmitz, B., Boschia, S., Cronholm, A., Heck, P.R., Monechi, S., Montanari, A. and Terfelt, F. (2015) Fragments of Late Eocene Earth-Impacting Asteroids Linked to Disturbance of Asteroid Belt. *Earth and Planetary Science Letters*, **425**, 77-83. https://doi.org/10.1016/j.epsl.2015.05.041