Increased aperiodic hydrothermal-activity in defined submarine areas (volcanic areas and tectonic fractures) at a global scale

Please also read Part 2, Part 3 & Part 4 (or here: P2, P3 & P4) / Weblink to extended version of Part 1 of my Climate-Hypothesis: Part 1e (with Chapter C4)

Abstract:

My study provides evidence of the real sources of the SST-anomalies which lead to the development of El Ninos: These are hydrothermal sources, which are located in the Kermadec-Tonga-Arc (e.g.in the Monowai- & Macauley-Volcanic-areas), New-Hebrides-Trench-area, Nankai-Trough- & Philippine-Plate-area, Salado-Fracture-Zone, Falkland-Aguilhas-Fracture-Zone, South-West-Indian-Ridge-area, Mid-Atlantic-Ridge, LFZ, Kane-Fracture-Zone & in the Pacific-Plate east of Japan, to name the important locations.

The cause of El Nino-events seems to be hydrothermal-water that rises from submarine volcanic-areas & tectonic-fractures to the surface! On the ocean surface this hydrothermal-water appears in the form of growing plumes or-blobs (sea-surface-temperature (SST)-anomalies), which then get distributed by the main ocean-currents and by surface-currents.

With the NASA Worldview tool an analysis of the sea-surface-temperature (SST)-anomalies was done for the time-period Oct. 2021 to June 2023, and for the time-periods in which the strong El Ninos from 1997/98 & 2014-16 developed. Five areas (1-5) on the ocean-floor were found where large amounts of hydrothermal-water was rising from specific areas on the ocean-floor to the surface at irregular intervals during the mentioned time-periods!

Note: The irregular hydrothermal-activity in these five areas is a global phenomenon!! The hydrothermal-activity comes and goes in a “wave-like-pattern”, which often causes activity in 3 to 5 areas, which are thousands of km apart, at nearly the same time!!

As an example I want to mention the period 9.12.2013 to 21.12.2013 (12 days) in which the hydrothermal-activity reached a maximum level in at least four of the five areas (1-5) in this very short time-period! Note: These areas are located in the northern- & southern-Hemisphere. And the hydrothermal-activity, which starts at nearly the same time and reaches a maximum activity at nearly the same time, comes in a “wave-like-pattern” and it seems to move from west to east over the globe. Changes in Earth’s Magnetic Field seem to be the main cause of this increased Hydrothermal-Volcanic-Activity! These changes (e.g. geomagnetic jerks) in Earth’s Magnetic-Field can be caused either by internal processes which take place near the Core-Mantle-Boundary (CMB), or they can be caused by external events, which are strong geomagnetic-storms caused by solar wind (space-weather). First the geomagnetic-changes (e.g. geomagnetic-jerks) seem to increase seismicity in High-Geothermal-Flux (HGF)-areas, then with a certain delay hydrothermal-activity, especially along tectonic-fractures, is increasing, which then rises the SST and the Ocean-Heat-Content, and finally causes the El-Nino.

The key to find the hydrothermal- or volcanic-sources, which cause the strong temperature-anomalies, is the precise observation of the development of every major anomaly in an animation, from the early beginning of the SST-anomaly, when the first small warm-water-blob appears on the surface! Please also read Part 2 & Part 3 of my hypothesis which explain the probable causes of the described “global-hydrothermal-activity” in more detail!

Please also read Part 2 & Part 3 & Part 4 (or here: P2, P3 & P4) / Weblink to extended version of Part 1 of my Climate-Hypothesis: Part 1e (with Chapter C4)
Introduction:

The Sea-Surface-Temperature-map shows the Absolut Temperatures of the ocean-surface at a certain point of time. It doesn’t give us any information where the warm water is coming from, which is slowly heating our oceans and causes climate-change. (→ see the 2. map on the bottom)

But to find out where the warm water is coming from, that is causing the El-Nino-events, which happen at irregular intervals of 2 to 7 years and which are mainly responsible for the heating of the ocean water, we must find the sources of the unusual temperature-anomalies!!

That’s what I did with this study here!

A temperature anomaly is a deviation of the surface-temperature in a certain area, in reference to the average of temperatures that were measured in this area over a long reference period (≥30 years).

The key to find the hydrothermal- or volcanic-sources, which cause the strong temperature-anomalies, is the precise observation of the development of an anomaly in an animation from the early beginning when the first small warm water blob appears on the surface!

→ See examples in Appendix 1.1  → How to use & see the animations

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Overview: In 5 defined areas large amounts of hydrothermal-water rise to the ocean-surface at irregular intervals!

With the NASA Worldview tool an analysis of the sea-surface-temperature (SST)-anomalies was done, for the time-period Oct. 2021 to June 2023. Five areas (1 – 5) on the ocean-floor were found where large amounts of hydrothermal (hot)-water rises from the ocean-floor to the surface at irregular intervals! 24-11-2022: the Hydrothermal-source-areas of strong SST-anomalies

South Atlantic: Tectonic Fracture Zones are the source of strong hydrothermal activity in the Argentina-Basin

By analysing the development of the strong SST-anomalies which were visible east of Argentina in 2021/22 and in 2013-15, I found clear evidence for ≥10 stationary hydrothermal-sources (vents) which are located along the Salado-FZ (SFZ), and located along the Falkland-Agulhas-Fracture-Zone (FAFZ) ! The SST-anomalies did develop precisely along the mentioned tectonic fracture zones !

Topographical map of SE-South-America overlain by basins & structural elements

South Pacific: The Kermadec-Tonga Arc area is a main source of hydrothermal-activity

By analysing the sea-surface-temperature (SST)-anomaly map of the SW-Pacific area on selected dates, it becomes clear that the SST-anomalies (the strong positive anomalies (red= warmest)) are purely the result of hydrothermal- and volcanic-activity in the Kermadec-Arc- & New-Hebrides-Trench areas & South-Rennell-Trough area !! (→ see images on the left !)

The SST-anomalies can clearly be traced to very active submarine-volcanic-regions like the Monowai- & Macauley- Volcanic-areas and to a number of tectonic-fractures & -trenches!

The SST-anomaly from 30.11.2014 for example, shows a very large warm-water plume that was caused by two submarine-volcanic-areas, the Monowai- & Macauley- Volcanic-areas !

Southern- & Indian Ocean: Along tectonic fractures hydrothermal-activity is visible

Other strong hydrothermal-sources are located along mostly Linear-Tectonic-Fractures south-west to south-east of South Africa. Note the precisely linear SST-Anomalies that are visible on the map ! (indicating fractures). Other big hydrothermal-vents are located near the Reunion-Hotspot and the SWIR
5 North Pacific : Hydrothermal-sources in a trapezoid-shaped fracture-field cause strong SST-Anomalies

This **trapezoid**-shaped fracture-field with many dozens of aperiodic-active strong **hydrothermal**-sources has a defined Northern- & Southern-borderline. The **SST**-anomalies can be traced to **hydrothermal-vents** located along linear fractures within this **trapezoid**-shaped fracture-field. The fracture-field has a relatively clear defined northern- & southern border. The western border of the fracture-field is the Japan Trench (→Tohoku-area). And its eastern-border is defined by an area in East-USA that is exposed to a high tectonic strain-rate. The whole trapezoid area seems to be exposed to high strain.

Beside the described trapezoid-shaped source-area, there is another **source-area** of **hydrothermal vents** which causes strong **SST-anomalies** in the North-Pacific. (→see image on the right)

This other source-area is located south of Japan and consists of the Shikoku Basin, the North Kyushu-Palau-Ridge (KPR) and the Nankai-Trough. During the 2014-16 El Nino **warm water plumes** were coming from 4 sources in these areas, as the **SST-anomalies** clearly show! →

4 North Atlantic: A hydrothermal source on the ocean floor caused a large SST-anomaly

In June 2023 a very strong **sea surface temperature (SST)**-anomaly developed in the North Atlantic.

This strong **SST-Anomaly**, which has the clear shape of a **warm water plume**, was caused by a strong point-like **hydrothermal source** which is located **650 km SW of Cape Race** (Newfoundland). →see image on the right!

The large **warm water plume** that was caused by this hydrothermal source had the size of Western Europe!

The hydrothermal-source in all probability is a crack or a volcano that is located on a **Linear Fracture Zone (LFZ)**, which must be a deep tectonic-strike-slip-like-fracture zone.

The fact that the big 2023 SST-anomaly in the North-Atlantic can precisely be traced to a point-like **hydrothermal-source** is another clear proof, that unusual **warm water**-anomalies in the oceans are purely the result of **hydrothermal-activity**!

Other hydrothermal-vents which also produced **warm water plumes**, are located along the marked **Linear Fracture Zone (LFZ)**, along **other Fractures** and along the **Mid-Atlantic-Ridge**. But these other hydrothermal-sources (-vents) produced smaller plumes than the giant 2023-plume.

I describe these other hydrothermal-sources (-vents), which caused SST-anomalies during the 1997/98 & 2014-16 El Ninos, on the following pages of this study.

An analysis of Sea-Surface Temperature (SST)-anomalies in the SW-Pacific-region from Nov. 2021 & Nov./Dec. 2022 with the help of the NASA-Worldview tool was done. This analysis provides clear evidence, that the largescale SST-anomalies visible on the SST- (L4,MUR)-anomaly-map have nothing to do with Global Warming caused by CO2!

It clearly visible on the SST-maps of different dates, that the SST-anomalies are purely the result of hydrothermal- & volcanic-activity in the Kermadec-Arc- & New-Hebrides-Trench regions! (see images!) The SST-anomalies can clearly be traced to active submarine-volcanic-regions like the Monowai- & Macauley-volcanos and tectonic-fractures!

The hydrothermal vents which cause the SST-anomalies (warm-water plumes) are located in these submarine/volcanic areas:

1. Maccauley volcano area
2. Maccauley-fracture (near CR)
3. Maccauley-fracture (west)
4. Monowai volcano area
5. Monowai-fracture (near LR)
6. Monowai-fracture (west, near HR)
7. Monowai-fracture (east, Pos.1)
8. Monowai-fracture (east, Pos.2)
9. New Hebrides Trench (Pos. 1)
10. New Hebrides Trench (Pos. 2)
11. South Rennell Trough
12. Puysegur Trench (NZ-Alpine Fault)
2021-23: The extreme SST-anomaly in the Atlantic in 2023 was caused by a hydrothermal-source in a deep tectonic-fracture zone.

The extreme 2023-SST-anomaly in the Atlantic can be precisely traced to a small area which is located ~650 km SE of Cape Race on a long Linear Fracture-Zone (LFZ). The hydrothermal-source of the extreme 2023-warm-water-plume is located ~650 km SW of Cape Race (Newfoundland) on the marked LFZ, which seems to be a deep strike-slip fracture which is oriented precisely along the long-axis of the linear Kelvin Seamount. Other hydrothermal-vents are located on the Mid-Atlantic Ridge and on other LFZs.

Strong SST-anomalies in the North-Pacific can be precisely traced to a trapezoid-shaped fracture-field located between the Japan-Trench & the East-coast of USA. The trapezoid-shaped fracture-field with many dozens of aperiodic-active strong hydrothermal-sources has a clear defined Northern- and Southern-borderline. Its left border is the Japan Trench and its right border is an area in East-USA exposed to high strain.

Topographic map

Note the linear (volcanic) ridges which indicate fractures

USA

China

Japan

The trapezoid-shaped fracture-field with many dozens of aperiodic-active strong hydrothermal-sources has a clear defined Northern- and Southern-borderline. Its left border is the Japan Trench and its right border is an area in East-USA exposed to high strain.
2021-23: Hydrothermal-sources along tectonic fractures in the South-Atlantic caused strong SST-anomalies.

Strong SST-anomalies can be traced to the Falkland-Augulhas-(FAFZ) & Salado-Fracture-Zone (SFZ) and to other linear fractures.

It is clearly visible that hydrothermal-sources are located east of Argentina along the Salado-FZ (SFZ), which seems to be the extension of the Chile-FZ (CFZ) through the South-American Continent, and along the FAFZ!

Other strong hydrothermal-sources are located on a Linear Fracture south of South-Africa, which seems to be the extension of the SFZ, and they are located on other Linear Fractures south of South-Africa.

Details

2022/23

2021

2023: ≥5 Hydrothermal-sources near West-Africa & in the Canaries

Two big SST-anomalies can be traced to a submarine caldera Ø6km~250km SSW of Cape Skirring and to another submarine volcano ~350km south of Cape Skirring, which is located in the mid between Dakar & Monrovia.

There are 3 other sources in this area. Another source is located ~100 km north of Lanzarote in the Canaries.
To the probable causes of increased global hydrothermal activity, which leads to El Nino events:

- Changes in Earth’s Magnetic Field seem to be the main cause of increased Hydrothermal- & Volcanic-Activity on Earth!

These changes (e.g. geomagnetic jerks) in Earth’s Magnetic-Field can be caused either by internal processes which take place near the Core-Mantle-Boundary (CMB), or they can be caused by external events, which are strong geo-magnetic-storms caused by solar wind (space-weather). The maximum impact of the external events (geo-magnetic storms) seems to be around +/- 20%, and the impact of internal-effects seems to be around +/- 30% (→ charts on the left). As internal effect the fast North-Magnetic Pole Shift must be mentioned, which showed a very high acceleration between 1993 and 2002.

Increased changes in Earth’s magnetic field caused by internal-processes (→ indicated by the 1.derivative of the Y-component) cause increased seismicity (earthquakes) which then lead to increased volcanism & hydrothermal-activity. Geomagnetic storms caused mainly during solar-cycle-maximas increase this correlation.  

The comparison of the 3 charts on the left indicates that volcanic activity is influenced by shortterm geo-magnetic effects, caused by the sunspot cycles (space weather) and by a longterm geo-magnetic effect, the NMPV. The chart of the Worldwide Active Volcanos per Year clearly follows a very similar trend as the chart of the North Magnetic Pole Velocity (NMPV). This trend is only interrupted by drops (lows) caused by sunspot cycle minimas.

Correlation of “Total Volcanic Eruptions” with “strong Geomagnetic storm-periods”:

Shortly after the occurrence of a strong Geomagnetic-storm-period, or with a delay of up to 1-2 years, there is a sharp increase in the number of Total-Volcanic Eruptions visible in the chart! (Highs, indicated by red arrows). And lows in the chart correlate with phases where no or very less geo-magnetic storms occurred (→ the blue arrows).


Increased changes in Earth’s magnetic field caused by internal-processes (→ indicated by the 1.derivative of the Y-component) cause increased seismicity (earthquakes) which then lead to increased volcanism & hydrothermal-activity. Geomagnetic storms caused mainly during solar-cycle-maximas increase this correlation.  

The Ocean Heat Content in the depth-range 2000-5500 m did not increase in the time-period ~1950 to 1990 !!  

But after 1995 it increased rapidly !!!
The **Ocean Heat Content** chart provides proof that hydrothermal-sources contribute at least \( \approx 40 \% \) heat to the Oceans!

The ocean heat content (OHC) is the energy absorbed and stored by the world's oceans. The current hypothesis says that the main driver of the OHC-increase most likely is "Anthropogenic (human) forcing via rising Greenhouse Gas Emissions". But a look at the diagram of the "Global Ocean Heat Content Anomalies" clearly indicates that the current official hypothesis is incorrect and incomplete! And therefore the current "Climate-Change Models" are incorrect too!

There are clearly time-periods (El Nino events) visible in the chart where the ocean heat-content (and the sea-level!) rises much faster than in other (cooler) periods, by a factor of 2.6 to 4.6!! This fact can't be explained by the greenhouse-theory alone!! This big difference in heat-input can only be explained by another additional powerful heat-source beside the sun that contributes heat!!

This other heat-source are hydrothermal-vents & submarine-volcanism on the ocean-floors!!

I have marked four time-periods on the OHC - Chart on the right:

1. El Nino 1997/98 (a 2-year period was selected) → Heat input in this time = \( 16.4 \, \text{ZJ/Year} \)
2. El Nino 2014-16 (a 2-year period was selected) → Heat input in this time = \( 16.4 \, \text{ZJ/Year} \)
3. El Nino 2002/03 (a 1.5-year period was selected) → Heat input in this time = \( 28.7 \, \text{ZJ/Year} \)

For comparison I have picked out a time-period with a low OHC-increase:

4. Reference (for comparison a cool 7.5 year period) → Heat input in this time = \( 6.2 \, \text{ZJ/Year} \)

( Note: \( 1 \, \text{ZJ/Y} = 1 \times 10^{21} \, \text{Joule / year} \))

To put the numbers in perspective:

The El Nino events 97/98 & 14-16 added \( 10.2 \, \text{ZJ/Y} \) more heat to the world's oceans than the (cooler) years: 2004 - 2011 (\( \rightarrow 16.4 - 6.2 = 10.2 \, \text{ZJ} \))

The El Nino 2002/03 even added \( 22.5 \, \text{ZJ/Y} \) more heat!

For comparison: \( 10.7 \, \text{ZJ} \) is the energy which the Earth's surface receives from the sun in one day!

The whole global economy uses \( 0.58 \, \text{ZJ/Y} \)

How much hot magma (lava) could add \( 10.2 \, \text{ZJ} \) heat to the oceans?:

Answer: approx. \( 6375 \, \text{km}^3 \) of hot magma (basalt) which cools down from \( 1300^\circ \text{C} \) to \( 27^\circ \text{C} \) (\( \Delta T=1000^\circ \text{K} \))

This volume of \( 6375 \, \text{km}^3 \) corresponds to \( \text{is equal to} \) a cube of magma with the edge-length of \( = 18.5 \, \text{km} \)

This is a very realistic scenario!!

**Note:** For my assessment I have used the well established OHC - EN4-Chart (0 - 2000 m)

( \( \rightarrow \) see info in Appendix3 )

**Note:** the EN4-Chart (0-2000m) used in the diagram above, was extracted from a study which aimed to reconstruct a new long-time OHC-dataset to better understand climate-events.

\( \rightarrow \) weblink to this study: LSTM-method Study

The Global Mean Sea Level (GMSL) diagram on the right also clearly indicates that the El Nino periods are the main driver of the sea-level-rise !!!

The analysis-result:

During the 5.5 El Nino years (1-3) \( \approx 108.7 \, \text{ZJ} \) heat were added. In the rest 22.5 years of the \( \approx 28 \, \text{year} \) long OHC-chart, \( \approx 103.8 \, \text{ZJ} \) heat were added. This corresponds to only \( = 4.61 \, \text{ZJ per year} \)

If I use this \( 4.61 \, \text{ZJ} \) as average added per year without El Ninos (1-3) which is \( = 129 \, \text{ZJ} \) for 28 years. Then the greenhouse-warming adds \( 129/212.5 = 60.7\% \)

And El Ninos added \( \approx 39.3\% \) to the OHC, (103.8+108.7=212.5 ZJ)

This corresponds to \( \Delta \text{GMSL} \) which is \( \approx 28 \, \text{years} \)

See chart on the right. 

Note: sea-level-rise was mainly caused by Expansion of the heated ocean water.
Volcanism is correlated to geo-magnetism, HGFA-seismicity, solar-cycles & global warming

A comparison of the 3 charts below indicates that volcanic activity is influenced by shortterm geo-magnetic effects, caused by the sunspot cycle (=space weather) and by a longterm geo-magnetic effect, the MPV.

The chart of the Worldwide Active Volcanos per Year clearly follows a very similar trend as the chart of the North Magnetic Pole Velocity (N-MPV) if we consider a smoothed chart of the Active Volcanos/Year (dotted line) When the MPV reached the wide Peak 2 with ≥ 40 km/year we can see a sharp rise & elevation of the volcanic activity. If we look at the chart of the worldwide active volcanos per year we clearly see sharp rises of activity in the years 1997-99, 2003-07, 2014-15 & 2020-22 interrupted by two drops caused by sunspot cycle minimas

Note that we had El Ninos events with increased Sea Surface-temperatures in the years 97/98, 2003-05, 2007-14-15 and a new El Nino episode just started in 2022. The impact of the high MPV on Volcanism is ≈30% and that of solar cycles ≈20%

Further some studies show a clear correlation of seismic activity in High-geothermal-flux-areas (HGFA) and the Global Warming of the last few decades (see: Study & Study-update) → see charts → HGFA-areas are all mid-ocean-ridge-areas and geothermically active areas. It is important to note that there is a delay of around 2 years between the seismic activity and the reaction of the global climate-system. (see charts on the right).

There is also a delay of ≈ 2 years noticeable between the seismic activity in the HGFA-areas and the global volcanism (in the chart represented by active volcanos per year) → see charts on the right. This delay can be explained by the time needed for magma and/or hydrothermal fluids to rise from Earth’s mantle and Earth’s crust to the surface, after new fractures have opened up in Earth’s crust, caused by increased seismicity resulting from the mentioned geo-magnetic effects. (magnetic pole-speed & geomagnetic storms)

Further it’s important to note that the distinct jump in seismic activity to a higher level in the HGFA-areas, which we see in the chart in the years 1995-1997, was followed by a strong increase in the growing-rate of the Ocean Heat Content since around 1996 and followed by a strong peak in global tropospheric-temperature-anomalies ( → see charts on the right).

Here are weblinks to infos & studies that also indicate such correlations:

1.) - Correlation between solar activity and large earthquakes worldwide
2.) - Solar-terrestrial effect influences volcanism & global seismic activity
3.) - Correlation of geomagnetic anomalies with earthquakes & solar storms
4.) - Volcanic eruptions are correlated with Solar Activity
5.) - Links of Volcanic Eruptions to Solar Activity and Solar Magnetic Field

More weblinks to similar studies under References (see last pages)
El Nino 2013-15: Analysis of the Migration-paths of hydrothermal-water from the source areas 1 to 5 that was causing the El Nino

Mid of December 2013 ( & in 2014 again ) hydrothermal-sources located in the source-areas 1 – 5, near hotspot-areas or mid-ocean-ridges in the Southern- & Northern-hemisphere, became active nearly simultaneously !! and ejected a lot of warm water into the oceans, as the sea-surface temperature anomalies indicate. The best examples are the Monowai- & Macauley- submarine-volcanos in the Kermadec Arc ! After this „global hydrothermal-event(s)” ocean- and wind-currents distributed & transported the warm water mainly eastward. Most of the warm water finally accumulated in the Pacific off the W-coast of South- & North-America.

This image shows a crucial scene at the beginning of the El Nino event where we can see the hydrothermal-source areas ( pink circles ) which are nearly all active at the same time.

In the time period 25.4. to 10.5. a considerable amount of warm water moved between Indonesia and New-Guinea, from the Indian Ocean to the Pacific.

Note: In the area indicated by the red ellipse warm water accumulates and then gets pushed towards east by westerly wind bursts & cyclone-activity.

Ocean Currents worldmap ( for Reference )
The animation of the Sea-Surface Temperature (SST)-anomalies of the 2014-16 El Nino provides evidence for the real cause of strong SST-anomalies (warm-water Blobs)!

In the animation it is clearly visible that the cause of the strong anomaly that developed in the time 24.11.-30.11.2014 was submarine volcanism and/or hydrothermal activity!!

The image sequence from 24.11.-30.11.2014 shows two warm-water plumes which were caused by the Monowai- & Macauley- submarine volcanos in the Kermadec Arc (KA)!

2014 : Two big warm-water plumes caused by the Monowai- & Macauley- Volcanos in the Kermadec-Arc caused large SST-anomalies

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Detail 2: shows two hydrothermal sources in the Kermadec Arc (KA)Probably located in the regions of the Monowai- & Macauley volcano

Detail 3: shows a different activity phase of the volcanos of the KA, in which volcanos in the Tonga-region & the Monowai volcano were active

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Detail 3: shows a different activity phase of the volcanos of the KA, in which volcanos in the Tonga-region & the Monowai volcano were active

The image sequence from 24.11.-30.11.2014 shows two warm-water plumes which were caused by the Monowai- & Macauley- submarine volcanos in the Kermadec Arc (KA)!!

2014 : Two big warm-water plumes caused by the Monowai- & Macauley- Volcanos in the Kermadec-Arc caused large SST-anomalies

The animation of the Sea-Surface Temperature (SST)-anomalies of the 2014-16 El Nino provides evidence for the real cause of strong SST-anomalies (warm-water Blobs)!!

In the animation it is clearly visible that the cause of the strong anomaly that developed in the time 24.11.-30.11.2014 was submarine volcanism and/or hydrothermal activity!!

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2013: Large SST-anomalies caused by hydrothermal-sources on 4 very different places at the same time indicate a global phenomenon.

The image sequence below shows the early beginning of the 2014-16 El Nino. The warm water which caused the strong El Nino-event at the Pacific-equatorial-region in 2015 already started to accumulate on the surface of the world oceans in December 2013! December 2013 is a crucial point in time in order to understand the real cause of El Ninos, because this time allowed to notice the real sources of the warm water that later caused the El Nino SST-anomalies. On the images I marked 4 positions where Warm-water Blobs developed on the surface at the same time, which were fed by submarine volcanism and/or hydrothermal-sources! For the Kermadec-Arc-region I already described the probable hydrothermal-sources (see previous page). For the other 3 locations marked on the SST-anomaly-map (1-3) I describe the probable hydrothermal-sources below.

Note: Important is the fact that on all 4 positions the volcanic &/or hydrothermal-activity started & increased nearly at the same time! This indicates a global phenomenon!

**SST-anomaly caused by the Reunion-hotspot:**

The SST-anomaly that developed east of Madagascar came from hydrothermal-sources in the Reunion-area (e.g. Piton de Fournaise, Rodrigues-Ridge, CIR etc.)

**SST-anomaly developed near the Chile Rise:**

This SST-anomaly (warm-water Blob) developed at or near the Chile Fracture Zone, which is located at the southern boundary of the Nazca Plate. It belongs to the Chile Rise, an earthquake-rich fracture zone.

**Description of the hydrothermal source visible in Detail 3 → see next pages!**

Piton de la Fournaise is a large and very active shield-volcano – Base Ø 200 km !!
1997: **Hydrothermal-sources** near the SWIR & hotspots, caused SST-anomalies


The large **Warm-water Blob** that developed south of Madagascar in Jan. & Feb. 1997 during the 1997-98 El Nino was caused by many **hydrothermal-/volcanic-sources** (≥ 16) on the ocean-floor which are located close to the following **hotspots**: Marion-, Del Cano-Rise-, Crozet-hotspot, and located close to the South-West-Indian-Ridge (SWIR), the Agulhas LIP or the Kerguelen Plateau (LIP). The small red **Blobs** are no Eddy’s on the surface! These blobs are stationary-hydrothermal sources as the SST-anomalies from 13th Dec. 2013 indicate! At that date the (nearly) same pattern of red **Blobs** (→ blobs at nearly the same positions!) is visible! However here the hydrothermal-sources were considerably less active.

Earthquakes ≥ 6.0 along the plate boundaries – 1990 to 2023.06

**Note:** At the start of the 2014-16 El Nino event the same pattern of **Warm-water Blobs** is visible as during the 1997-98 event! The small red **blobs** indicate considerable less intensity of the hydrothermal sources if compared with the 97/98 El Nino. Some sources are inactive. The deep blue blobs probable represent lateral up-welling cold-water.

**Note:** the positive Geoid anomaly under the hydrothermal source area!
At the beginning of the 2014-16 El Nino event, there was a strong warm-water anomaly developing in the Atlantic Ocean, starting around Dec. 18th 2013 (see images on the left). Like the other strong SST-anomalies of the 2014-16 El Nino this Warm-water Blob in all probability was caused by a strong hydrothermal-event/submarine volcano on the ocean floor too.

Indication for this assumption comes from the fact, that the warm-water anomaly precisely developed above the Mid-Atlantic Ridge (MAR), as the center-point of the SST-anomaly indicates. This point is close to the Rio-Grande Fracture-Zone, which is orientated perpendicular to the MAR. Near the indicated area of the Mid-Atlantic Ridge (MAR) earthquakes >5.0 took place in the time 2013-16. The island Tristan da Cunha is located around 650 km south of the shown warm-water-blob above the MAR. Because this blob developed not far away from the Tristan da Cunha hotspot (TdC) where a large mantle plume is located below Earth’s crust, there is the probability that the hydrothermal-water from the TdC was moved a bit northward by currents.

Examination of the Tristan da Cunha area:
These images are from an exploration around Tristan da Cunha (TdC) that explored the submarine volcanic activity around this island, and which recorded the topography of the MAR-section west of the island. (This is the closest explored area to the hydro-thermal source which I found) → see Study

Bathymetry of the eastern South Atlantic:

The image from 18.12.2013 shows the second possibility where Tristan da Cunha is the true hydrothermal-source and surface currents accumulated the warm water further North.
2014-16 El Nino: At least 10 hydrothermal-sources in a trapezoid area east of Japan and ≥4 sources south of Japan caused SST-anomalies.

The animation of (SST)-anomalies of the 2014-16 El Nino indicates ≥10 hydrothermal/submarine-volcanic-sources in a trapezoid-shaped area east of Japan and ≥4 bigger sources south of Japan that caused warm water blobs/plumes! I marked the approximate positions of these stationary hydrothermal-sources with yellow and red dots on the topographic map. And I will describe the four yellow sources (1-4) in more detail. The probable hydrothermal sources 1 & 2 are located in areas with very thin Earth-crust with <5km at Pos.1! Source No.3 probably is the Nishinoshima- &/or Torishima (info) -volcanic-area. Source No. 4 is located in the Nankai-Trough-area where an extreme heatflow anomaly was detected. Note: The images below show a warm-water plume coming from this area!! For the other red-marked sources no info was found.

weblink to SST-animation: El Nino Watch 2015

weblink to Study

Note: During the 1997-98 El Nino event hydrothermal-sources in the same locations south of Japan were active as during the 2014-16 El Nino!


Note: An extremely high heat-flow anomaly has been detected in the central part of the Nankai Trough. A possible cause of the anomaly is reheating of the lithosphere by post-spreading thermal activities.

weblink to this Study!
In the animation SST-anomalies of the 2014-16 El Nino I have found ≥ 10 stationary hydrothermal-sources (-fields) on the ocean-floor east of the SE-coast of South America, which caused warm water blobs/plumes east of Argentina & Brasilia. Five of these hydrothermal-fields that were particular strong (& durable) are located along the Salado-Fracture-Zone (SFZ) And another 4 - 5 hydrothermal-sources (-fields) are located along the Falkland-Agulhas-Fracture-Zone (FAFZ) (→ see maps below). Other sources seem to be located in the area of the Rio-Grande Rise and near the continental shelf. I have marked the approximate positions of these hydrothermal-sources with yellow dots on the topographic map.

2014-16 El Nino: East of Argentina ≥ 10 hydrothermal-sources caused large SST-anomalies

In the animation SST-anomalies of the 2014-16 El Nino I have found ≥ 10 stationary hydrothermal-sources (-fields) on the ocean-floor east of the SE-coast of South America, which caused warm water blobs/plumes east of Argentina & Brasilia. Five of these hydrothermal-fields that were particular strong (& durable) are located along the Salado-Fracture-Zone (SFZ) And another 4 - 5 hydrothermal-sources (-fields) are located along the Falkland-Agulhas-Fracture-Zone (FAFZ) (→ see maps below). Other sources seem to be located in the area of the Rio-Grande Rise and near the continental shelf. I have marked the approximate positions of these hydrothermal-sources with yellow dots on the topographic map.

Another hydrothermal-source of the 2014-16 El Nino probably was caused by a submarine eruption-/hydrothermal-event in the Mariana Arc-area. This is indicated by eruptions of the Ahyi-volcano on 24.4.2014 and by new found volcanic activity in 2015 → Weblink1, Weblink2

New hydrothermal vents and new lava-flows were discovered in 2015 by an expedition in the shown section of the Mariana Arc (MA). Note: There are ≥ 260 volcanic-centers (sea-mounts) with ≥ 26 having hydrothermal vents in the MA → See: Weblink
2014-15 : Along the Mid-Atlantic Ridge, Kane Fracture-Zone and a new FZ, hydrothermal-vents caused SST-anomalies (plumes)

SST-anomalies of the 2014-16 El Nino show a number of active hydrothermal-sources (-fields) along the Mid-Atlantic Ridge (MAR), along a (new?) Linear Fracture Zone (LFZ) and along the Kane-Fracture Zone (KFF) which runs south of the Bermuda Hotspot (BR) from East to West. There were clearly visible warm-water plumes coming from hydrothermal-fields located on the Kane Fracture Zone (KFZ), on the LFZ and on the MAR in 2014 & 2015. Two of the found hydrothermal-fields are already known (Lost City & Menez Gwen) see:→ Weblink1, Weblink2

El Nino 2014-16 : date 30.5.2014 - time 1:26

known hydrothermal-fields along the MAR

Fracture Zones & Seamount-areas in the NW-Atlantic
Appendix 1: → How to use the NASA – Worldview tool & → How to analyse the sea surface temperature-anomalies by yourself

NASA – worldview is a free tool to analyse satellite images from ≥ 1000 data-sets (e.g. sea surface-temperatures, -anomalies, -salinity etc.)

To use this tool please follow these steps:

1.) Register as user on Worldview:
   - first goto: https://www.earthdata.nasa.gov/
   - then goto: Find data https://www.earthdata.nasa.gov/learn/find-data
   - then Register
   This is necessary to be able to use Worldview
   - then goto: Earthdata Login:
     https://urs.earthdata.nasa.gov/documentation/for_users/welcome

   Now you can start using the map tools.

   Goto: Find Data
   ← Then scroll down and clic on: Worldview (see image on the left)

    Worldview: (direct weblink) https://worldview.earthdata.nasa.gov/

2.) Starting the map tool
   To start the map-tool you must clic on the small arrow (triangular symbol) on the top menue. (→ yellow arrow)
   Then the shown menue-list appears.
   Disable all lines except of “Coastlines”
   Then clic on “Add Layers” (see image on the left)

3.) Then select the “Sea Surface Temaperture Anomalies” data-set. → Find that in the Categorie: All

4.) Now you can analyse the “Sea Surface Temaperture Anomalies” of the last few years in detail

   Here you can adjust a certain date. And with the arrows you can move back or forward in time.
   Clic here to start the animation tool
   Adjust a start- & end-date for the animation. (maximum is around one month). Use the loop-function to restart it automatically
   Use this indicator for a manual animation
Appendix 1.1: Animations of the Sea-Surface-Temperature-Anomaly worldmap

Recommended time-periods for own studies & observations, in order to get a feeling for the described „global-hydrothermal-phenomenon“

1.) see the Animation:  El Nino Watch 2015 - by Nasa/JPL/podaac - 29 November 2015
   weblink: https://podaac.jpl.nasa.gov/animations/ElNi%C3%B1o_Watch_2015
   Interesting is here the time period 9.12.2013 to 21.12.2013 (12 days) in which the hydrothermal-activity reached a maximum level in at least four of the five areas (1-5)
   This period corresponds to the movie-sequence 0:40 to 0:44. This movie-sequence shows the SST-anomalies of the whole December 2013. Please watch it a few times!

   weblink: https://podaac.jpl.nasa.gov/node/592
   Interesting is here for example the time period 15.1.1997 to 15.2.1997 (1 month) in which 3 of the 5 hydrothermally active areas get active and reach a maxima.
   This period corresponds to the movie-sequence ≈ 0:20 to 0:25

3.) use the NASA-Worldview as described on the previous page (Appendix 1) and activate the layer: „Sea Surface Temperature Anomalies (L4, MUR)“
   Interesting is here for example the time period 20.11.2021 to 20.12.2021 (1 month) in which 4 of the 5 hydrothermally active areas get active and reach maximum activity.
   Just adjust the dates as shown on the image below and activate the „loop-function“ (the blue button with the two arrows) and press start. Adjust a high frame-rate of 6 – 9.
   Note that with NASA-Worldview only SST-anomaly datas are available from 23.7.2019 to present. To observe older SST-datas you must watch older NASA-movies, see 1.) + 2.)
Appendix 2: El Ninos and the “warm” Pacific decadal oscillations have the same cause, activity-cycles of hydrothermal-sources on a global scale!

Periodic active hydrothermal-sources on the ocean floor, which are the root-cause of El Nino events, also cause “warm” PDOS! → the Pacific decadal oscillation (PDO) is a recurring pattern of ocean-atmosphere climate variability centered over the mid-latitude Pacific-basin. During a “warm,” or “positive,” phase of the PDO, the West-Pacific becomes cooler and part of the eastern ocean warms during a “cool”, or “negative”, phase, the opposite pattern occurs. ( → see image below! ) → the video time 0:03-0:07 shows the 2014 warm-PDO

In early 2014 there was a flip from the cool PDO-phase to the warm PDO-phase, which is similar to a long and extended El Nino event. This warm PDO-phase caused warm surface-water (the Blob) along the US-west-coast (→ see news article), and record-breaking surface temperatures worldwide in 2014, and it represented in principle the fore-runner (pre-stage) of the strong 2014-16 El Nino event!

The start of an El Nino event was indicated by a large area of warm surface-water near the international date-line (near the Marshall- & Gilbert-Islands). In the same area a large atmospheric convection was present in association with the development of an unusual amount of early-season tropical cyclones. After Typhoon Higos developed during February 2015, this indicated the start of an El Nino.

The image below shows the warm-phase of the Pacific decadal oscillation (PDO) and an El Nino event. During this warm-(PDO) phase the West-Pacific becomes cooler and part of the East-Pacific warms. Both events result from a global event in which many hydrothermal-sources on the ocean floors are active.

How can hydrothermal-sources cause El Nino events?:
1.) A global event in which many hydrothermal-sources on the worlds ocean floors are active causes big amounts of warm water that accumulates in the Pacific, especially in the West-Pacific near the date-line at the Equator.
2.) This big amount of warm water in the West-Pacific causes big convection cells near the equator which cause cyclones just north & south of the equator. Because of the Coriolis Force, this causes counter-rotating storms which cause strong westerly-wind-bursts & Kelvin-wave-systems that transport the warm water to South-America

Description of the 2014-16 El Nino event:
A change of the Pacific climate towards El Nino conditions was first indicated in late 2013 by an intense burst of typhoon-activity towards the end of 2013, and by persistent westerly winds until the end of 2014 at equatorial Latitudes, which were not displaced eastwards towards the Marshall Islands.

This typhoon-activity and the Westerly winds moved warm water from the Marshall- & Gilbert-Island-area to the US west-coast by June 2014. → this phenomenon was called “the (warm) Blob”

In the equatorial area an intense easterly-wind-burst in June 2014 stalled (delayed) the development of an El Nino for a few months. Then in January 2015, westerly wind-burst-activity picked up again, and the first Kelvin wave developed around March and another formed around May. (→ a Kelvin wave balances the Coriolis force against the equator. It is a wind-generated wave). More such Kelvin Waves developed and moved large amounts of warm water from west to east to South-America, along the equator, in the second-half of 2015 and early in 2016. The first Kelvin wave event was caused by strong westerly wind-burst events which were produced by the twin tropical cyclones (storms) Pam & Bavi that were positioned on both sides of the equator in March 2015. More such twin-cyclone events, which produced Kelvin waves, took place in July, October and in December 2015 into January 2016, causing the 2014-16 El Nino.
Appendix 3: Info to the **EN4 (Chart)** → subsurface temperature- and salinity- measurements for the global oceans

**EN4** → is a subsurface temperature and salinity dataset for the global oceans, spanning 1900 to present at a monthly timestep. It includes two types of data products: (1) a database of quality-controlled *in situ* profiles and (2) a spatially complete analyses at 1 by 1 degree horizontal resolution and 42 depth levels for 83S to 90N. Input data include Argo (Argo, 2000), ASBO (Arctic Synoptic Basinwide Oceanography), GTSP (Global Temperature and Salinity Profile Program) and WOD13 (World Ocean Database). The profiles include quality control flags while the analyses include observation weighting and standard error information.

**EN4** is used for monitoring ocean heat content and thermosteric sea level, initializing models and forecasts, and satellite data validation, among other applications. Due to the sparseness of ocean observations in some regions and time periods, studies of trends and variability should be approached with caution. Where observations are lacking, EN4 relaxes to a 1970-2000 climatology. Users should check the observation weights when doing such analyses.

**See weblink:** [https://climatedataguide.ucar.edu/climate-data/en4-subsurface-temperature-and-salinity-global-oceans](https://climatedataguide.ucar.edu/climate-data/en4-subsurface-temperature-and-salinity-global-oceans)

and: [https://en.wikipedia.org/wiki/Argo_(oceanography)](https://en.wikipedia.org/wiki/Argo_(oceanography)) → **Argo**: international program that uses profiling floats

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**Potential Temperature**

20831 profiles

**Blue dots**

represent 20831 measuring points
Please also read Part 2 & Part 3 of my Climate-Change-Hypothesis:

Weblink: [Part 2: Changes in Earth’s Magnetic Field are a main cause of Volcanism, Earthquakes, HGFA-seismicity & Global Warming](#) by Harry K. Hahn

Weblink: [Part 3: Correlation of Volcanism with geomagnetic-changes (solar storms and North-Pole shift)](#) - List of geomagnetic storms from 1800-2023

Sources of the Sea-Surface-Temperature (SST)-Anomaly - Maps used in my Analysis:

**NASA Worldview**
- direct weblink: [https://worldview.earthdata.nasa.gov](https://worldview.earthdata.nasa.gov) - Note: To use Worldview it is necessary to Register!! → see exlanation in Appendix 1!
- Short explanation: → How to register: → first goto: [https://www.earthdata.nasa.gov/](https://www.earthdata.nasa.gov/) → then goto: Find data: [https://www.earthdata.nasa.gov/learn/find-data](https://www.earthdata.nasa.gov/learn/find-data)
- then Register → then goto: Eartdata Login: [https://urs.earthdata.nasa.gov/documentation/for_users/welcome](https://urs.earthdata.nasa.gov/documentation/for_users/welcome)

Now you can start using the Worldview map tools. ! → Go again to: Find Data [https://www.earthdata.nasa.gov/learn/find-data](https://www.earthdata.nasa.gov/learn/find-data) → Then scroll down and clic on: Worldview

**Animations (Movies) of the Sea-Surface-Temperature Anomalies of the 1997/98 El Nino and the 2014-16 El Nino:**

**Animation: El Nino Watch 2015** - by Nasa/JPL/podaac - 29 November 2015  
weblink: [https://podaac.jpl.nasa.gov/animations/ElNi%C3%B1o_Watch_2015](https://podaac.jpl.nasa.gov/animations/ElNi%C3%B1o_Watch_2015)

weblink: [https://podaac.jpl.nasa.gov/node/592](https://podaac.jpl.nasa.gov/node/592)


**Animation: MEaSUREs Gridded Sea Surface Height anomalies – Version 2205** - by Nasa/JPL/podaac - 15 June 2022  

Studies regarding the Ocean-Heat-Content (OHC) and the fluctuations in the sea-surface-temperature (SST):

**EN4 – Global Ocean Heat Content dataset (chart)** - by UCAR  

weblink: [https://www.mdpi.com/2072-4292/13/19/3799](https://www.mdpi.com/2072-4292/13/19/3799)

**20 century cooling of the deep ocean contributed to delayed acceleration of Earth’s energy imbalance** - by A. Bagnell, T. DeVries  

**An Ocean View of the Global Surface Warming Hiat** - by Wei Liu & Shang-Ping Xie  

**A fluctuation in surface temperature in historical context: reassessment and retrospective on the evidence** - by James S Risbey, S. Lewandowsky & others  
weblink: [https://www.researchgate.net/publication/329763956_A_fluctuation_in_surface_temperature_in_historical_context_Reassessment_and_retrospective_on_the_evidence](https://www.researchgate.net/publication/329763956_A_fluctuation_in_surface_temperature_in_historical_context_Reassessment_and_retrospective_on_the_evidence)

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Weblink: [Part 3: Correlation of Volcanism with geomagnetic-changes (solar storms and North-Pole shift)](#) - List of geomagnetic storms from 1800-2023
Studies to Hydrothermal-Vents, Submarine-Eruptions, Tectonic-Fracture-Zones, Mantle-Plumes & Large-Igneous-Provinces

On the Global Distribution of Hydrothermal Vent Fields - by Edward T. Baker & Christopher R. German
weblink: https://www.pmel.noaa.gov/pubs/outstand/bake2544/bake2544.shtml

Volcanic Eruptions in the deep sea - by Kenneth H. Rubin, S. Adam Soule & others
weblink: https://www.researchgate.net/publication/236589699_Volcanic_Eruptions_in_the_Deep_Sea

Marine Transform Faults and Fracture Zones: A Joint Perspective Integrating Seismicity, Fluid Flow and Life - by Christian Hensen, Joao C. Duarte & others
weblink: https://oceanrep.geomar.de/id/eprint/46240/1/feart-07-00039.pdf

Mantle Plumes - by Cinzia G. Farnetani & Albrecht W. Hofmann

Low velocity channels in the oceanic asthenosphere from full waveform inversion using Spectral Element Method - by Scott French, Vedran Lekic & B. Romanowicz
Weblink 1: https://seismo.berkeley.edu/wiki_br/Low_velocity_channels_in_the_oceanic_asthenosphere_from_full_waveform_inversion_using_the_Spectral_Element_Method

Large Igneous Provinces: Crustal Structure, dimensions, and external consequences - by Millard F. Coffin & Olav Eldholm

Studies regarding the described hydrothermal active areas: 1 - 5 → Studies to volcanism, hydrothermal-activity, earthquakes etc. in these areas

1 - South-west Pacific:

Submarine hydrothermal activity along the mid-Kermadec Arc, New Zealand: Large-scale effects on venting - by C. E.J. de Ronde, E.T. Baker and others
weblink: https://www.researchgate.net/publication/235764446_Submarine_hydrothermal_activity_along_the_mid-Kermadec_Arc_New_Zealand_Large-scale_effects_on_venting

Two Decades of Monitoring Hydrothermal Plumes at the Brothers Submarine Arc Volcano, Kermadec Arc, New Zealand - by Walker, S., de Ronde, C., Baker, E.
weblink: https://ui.adsabs.harvard.edu/abs/2018AGUFM.V33A..03W/abstract alternative → Weblink 2

The largest deep-ocean silicic volcanic eruption of the past century - by REBECCA CAREY, S. ADAM SOULE, MICHAEL MANGA and others
weblink: https://www.sciencemag.org/doi/10.1126/sciadv.1701121

2019-2020 South Pacific Blob and Antarctica warming in February 2020 - by Wyss W.-S. Yim & Alvin Wong
→ see lecture on YouTube – movie: https://www.youtube.com/watch?v=dxBElsvlKGo → South-Pacific Blob: start around 6:30 - start of blob description at around 12:20 to 19:00, and see also the Info to the North Pacific blob: → see section 3:45 - 5:15, caused by the Nishinoshima submarine volcano
Earth’s deepest earthquake swarms track fluid ascent beneath nascent arc volcanoes - by Lloyd T. White, Nicholas Rawlinson and others
weblink: https://core.ac.uk/download/pdf/222805845.pdf

Analysis and Impact of the Hunga Tonga-Hunga Ha’apai Stratospheric Water Vapor Plume - by M. R. Schoeberl, Y. Wang & others

Tonga’s strange volcanic eruption was even more massive than we knew - BY MAYA WEI-HAAS

An examination of the junction between the Solomon Sea Plate, the Bismarck Plates and the Pacific Plate - by Keren Francis 2018

The Gilbert Islands Earthquake Swarm of 1981-83 (→ 86 earthquake-events had: mb > 5.0 & 217 events had: mb > 4.0) - by Thorne Lay & Emile Okal

Giant palaeotsunami in Kiribati (Gilbert Islands) in the 16th century: Converging evidence from geology and oral history

The Melanesian Volcanos – some of the top-10 SO₂ emitting volcanos on Earth are located in this area
weblink: https://www.volcano-waka-lab.com/volcanoes or: https://www.volcano-waka-lab.com/

2 - Southern-Ocean & Indian-Ocean:

Tectonic Background of Four Hydrothermal Fields Along the Central Indian Ridge - by Kyoko Okino, Kentaro Nakamura
weblink: https://link.springer.com/chapter/10.1007/978-4-431-54865-2_11

Influence of the Reunion/Rodrigues Hotspot on the Structure of the Central Indian Ridge Near 19°S - by Anne Briais, Marcia Maia
https://www.researchgate.net/publication/241529713_Influence_of_the_Reunion_Rodrigues_Hotspot_on_the_Structure_of_the_Central_Indian_Ridge_Near_19deg_S

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On the correlation between solar activity and large earthquakes worldwide – by Vito Marchitelli, Paulo Harabagia, Claudia Troise & Giuseppe De Natale
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Decadal timecale correlations between global earthquake activity and volcanic eruption rates - by A.P. Jenkin, J. Biggs & others

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Please also read my Hypothesis about the Permian Triassic Impact-Event (PTI) → weblinks to the Parts 1 to 6 of my hypothesis: → available on vixra.org

Weblinks to my studies on vixra.org:

Part 1: https://vixra.org/abs/2012.0210
Part 2: https://vixra.org/abs/2101.0052
Part 3: https://vixra.org/abs/2101.0096
Part 4: https://vixra.org/abs/2101.0067
Part 5: https://vixra.org/abs/2101.0127
Part 6: https://vixra.org/abs/2104.0099
Part 6b: https://vixra.org/abs/2110.0042

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