The Ø 50 km Archean Impact Crater (Age >3 Ga) in the Pilbara Craton (Australia) – A place where life on Earth started

see also Part 1 to 6 of my study: "**Global Impact Events are the cause for Plate Tectonics and the formation of Continents and Oceans**"

(→ Please find my other studies on vixra.org, archive.org , or soon on this website : www.permiantriassic.de)

by **Harry K. Hahn** / Germany - **8. July 2017**

Abstract :

The magnetic-anomaly- and gravity anomaly- map and geological maps indicate a very old ∅ 50 km Impact Crater in the Pilbara Craton near Marble Bar / Western Australia. This impact crater (structure) was formed by a large asteroid or comet (-fragment) which impacted in the Pilbara Craton (Western Australia) approx 3 -3.5 billion years (Ga) ago.

The impact structure, which probably is connected to the Barberton Greenstone Belt (BGB) Impact Event which happened 3.26 - 3.24 Ga ago in South-Africa, may be responsible for the development of some of the first life-forms on Earth approximately 3.25 Ga ago ! The Geologist Andrew Y. Glikson pointed out, that there seems to be a clear correlation between the Barberton Greenstone Belt (BGB) Impact event 3.26 – 3.24 Ga ago in South-Africa and stratigraphic units of the same age in the Pilbara Craton in West-Australia.

Both impact events, the Impact Event in the Pilbara Craton / West-Australia and the BGB Impact Event in the Kaapvaal Craton in South-Africa happened at the same time ! It is possible that both impact events were caused by the same impactor, probably a carbon-rich Comet. This comet probably collapsed just before the impact, and its fragments then formed the BGB impact structure, and the Ø 50 km Pilbara Impact Crater described in this study, which later led to the Strelley Pool Chert (stromatolite carbonate platform)

The development of the oldest known Stromatolites, that were found close to the two impact sites, in all probability was a longterm result of these two impacts and the organic-material which arrived together with the impactor (comet) fragments ! Water which ascended from Earth's mantle after the impact may have contributed to life development. There are only around 20 documented varieties of stromatolites for the period 2.8 - 3.25 billion years ago. The oldest 3.25 Ga Stromatolites are found in the Hooggenoeg Formation (Buck Ridge) / South Africa near the BGB Impact Structure and in the Dresser Formation / West Australia, less than 30 km away from each of the two impact sites !

There is also indication that the Pilbara Craton and the Kaapvaal Craton (the Barberton Greenstone Belt (BGB) were positioned side by side when the first Super-Continent Vaalbara formed 3.25 Ga ago just after the Impact Event. The BGB impact structure and the Pilbara impact crater probably were formed by the same impact event 3.25 Ga !

Therefore I want to propose the following hypothesis : Both impact events, the BGB Impact Event and the Pilbara Impact Event happened at the same time. These impacts were caused by the same impactor, which probably was a carbon-rich comet that contained organic compounds. The development of the oldest known stromatolites on Earth, found very close to the two impact sites in the Hooggenoeg Formation (S-Africa) and in the Dresser Formation (W-Australia) , was the longterm result of this special Impact Event !

Assumptions : 1.) The BGB impact event and the described Pilbara Impact Event have the same age and a very similar stratigraphy & sedimentary geology.

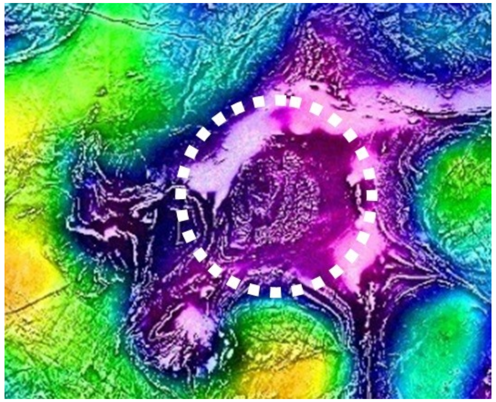
2.) Both impact sites were originally located very close together (probably only a few hundred kilometers apart) before the continental plates later drifted apart

3.) The areas where the oldest stromatolites on Earth can be found, are less than 50 km away from these two impact sites !

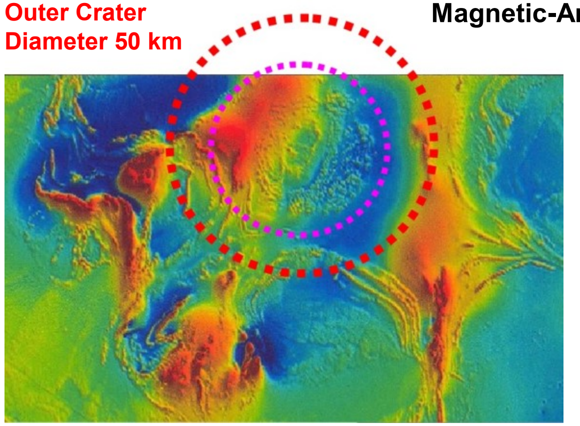
4.) The 3.25 Ga old stromatolites are found in the Hoogenoeg Formation / S-Africa and in the Dresser Formation / W-Australia, 30 km from the impact sites

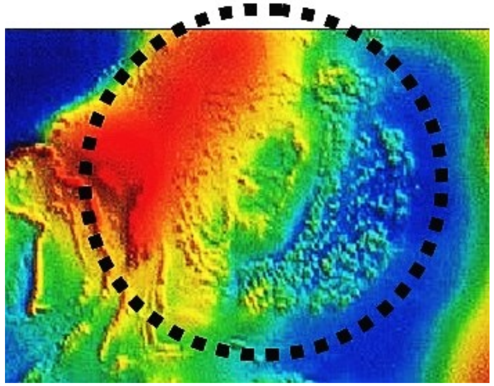
Satellite Image

Magnetic- and Gravity-Anomaly Map



Magnetic-Anomaly Map

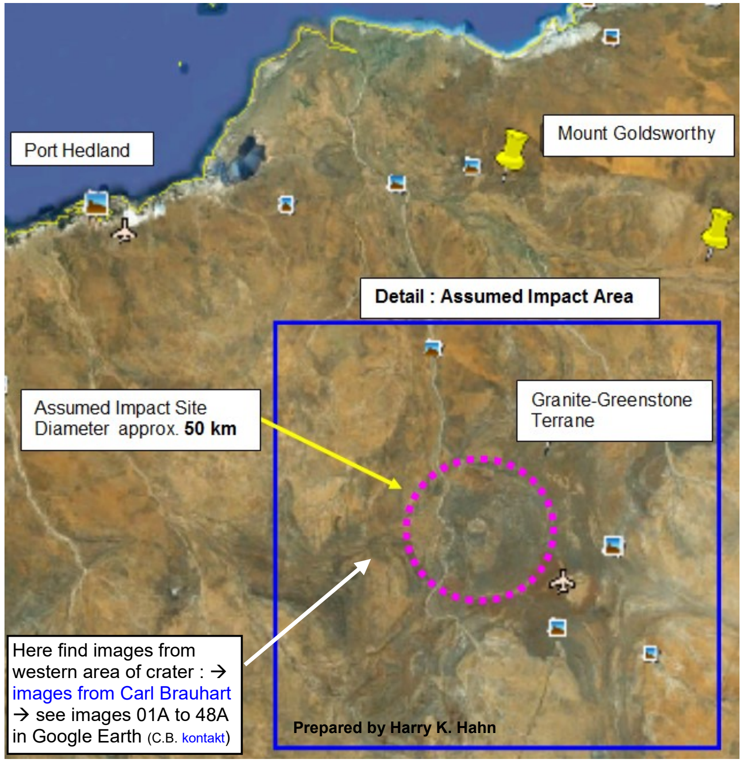


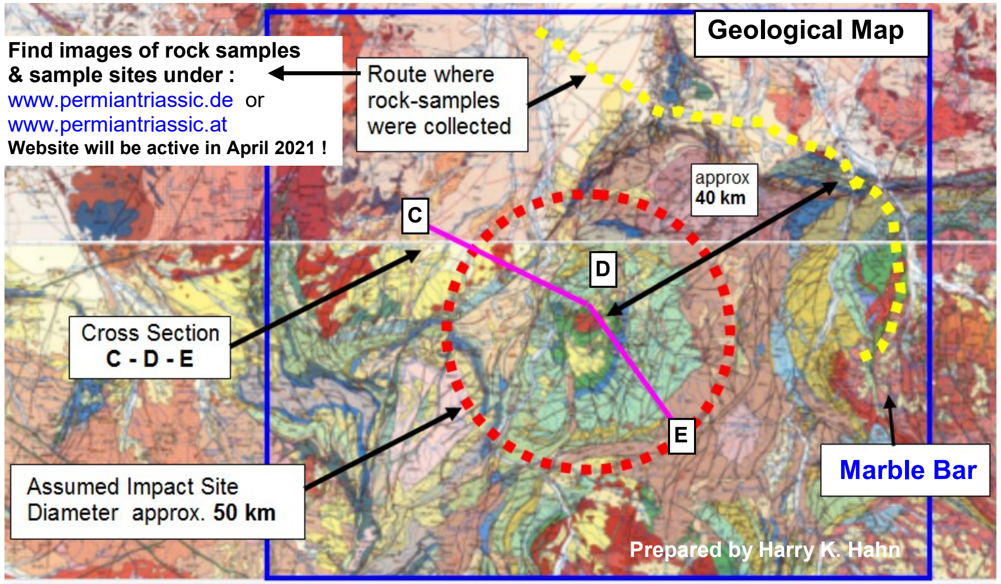


An old Archean Impact Crater ∅ 50 km (Age > 3 Ga) in the Pilbara Region near Marble Bar / Western Australia

This Impact Crater probably is connected to the BGB 3.26 - 3.24 Ga Impact Event in South-Africa.

The magnetic-intensity- & gravity anomaly –maps and different geological maps indicate a very old ∅ 50 km impact crater (structure) near Marble Bar / Western Australia. These impact structure probably was formed by a comet-fragment which impacted on the indicated position approx **3.25 Ga** ago. **This impact structure** may be connected to the BGB impact structure in South-Africa, and it **may be responsible for the development of the first life-forms on Earth ~3,25 Ga ago !**



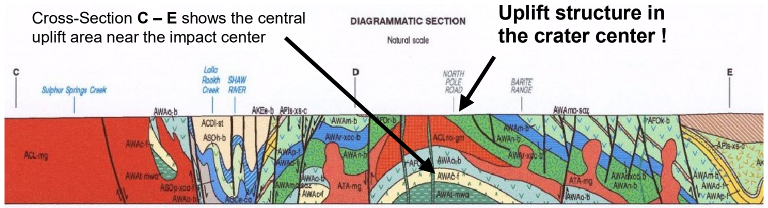


The Geologist Andrew Y. Glikson pointed out, that there seems to be a clear correlation between the BGB 3.26 – 3.24 Ga impact event in South-Africa and stratigraphic units of the same age in the Pilbara Craton **(→ the assumed impact event described in this document)**

Therefore I want to propose the following hypothesis :

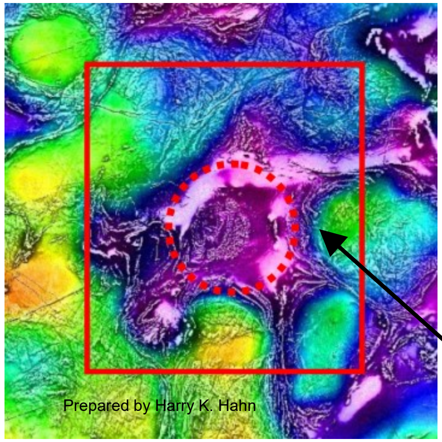
Both impact events, the BGB impact structure and this impact event in the Pilbaras occurred at the same time ! These impacts were caused by the same impactor, which probably was a Comet, maybe coming from the Oort Cloud, which broke apart when it reached the Roche Limit (approx. 10000 to 30000 km above Earth's surface).

The fragments of the comet then formed the BGB structure and the described Pilbara impact structure.



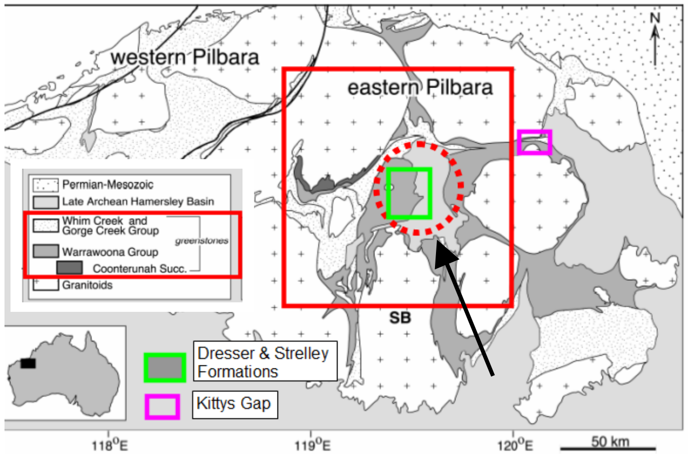
The later development of the **oldest known** Stromatolites, found very close to the two impact sites, was a direct result of these two impacts and the organic material which arrived together with the comet fragments

The oldest 3.25 Ga Stromatolites are found in the Hooggenoeg Formation (Buck Ridge) / South Africa and in the Dresser Formation / West Australia, **less than 30 km** away from the the two impact sites ! There is also strong indication that the Pilbara Craton and the BGB formed the first Supercontinent Vaalbara ~ **3.25 Ga ago.**



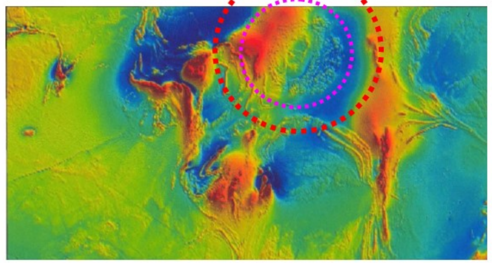
Combined magnetic intensity (first vertical derivative) and gravity image of the Eastern Pilbara Granite-Greenstone Terrain (R.Blewett, National Geoscience Mapping Accord, AGSO-Geoscience Australia). The image shows the distinct ovoid outline of the granitoid complexes, surrounded by greenstone belts

∅ 50 km impact structure



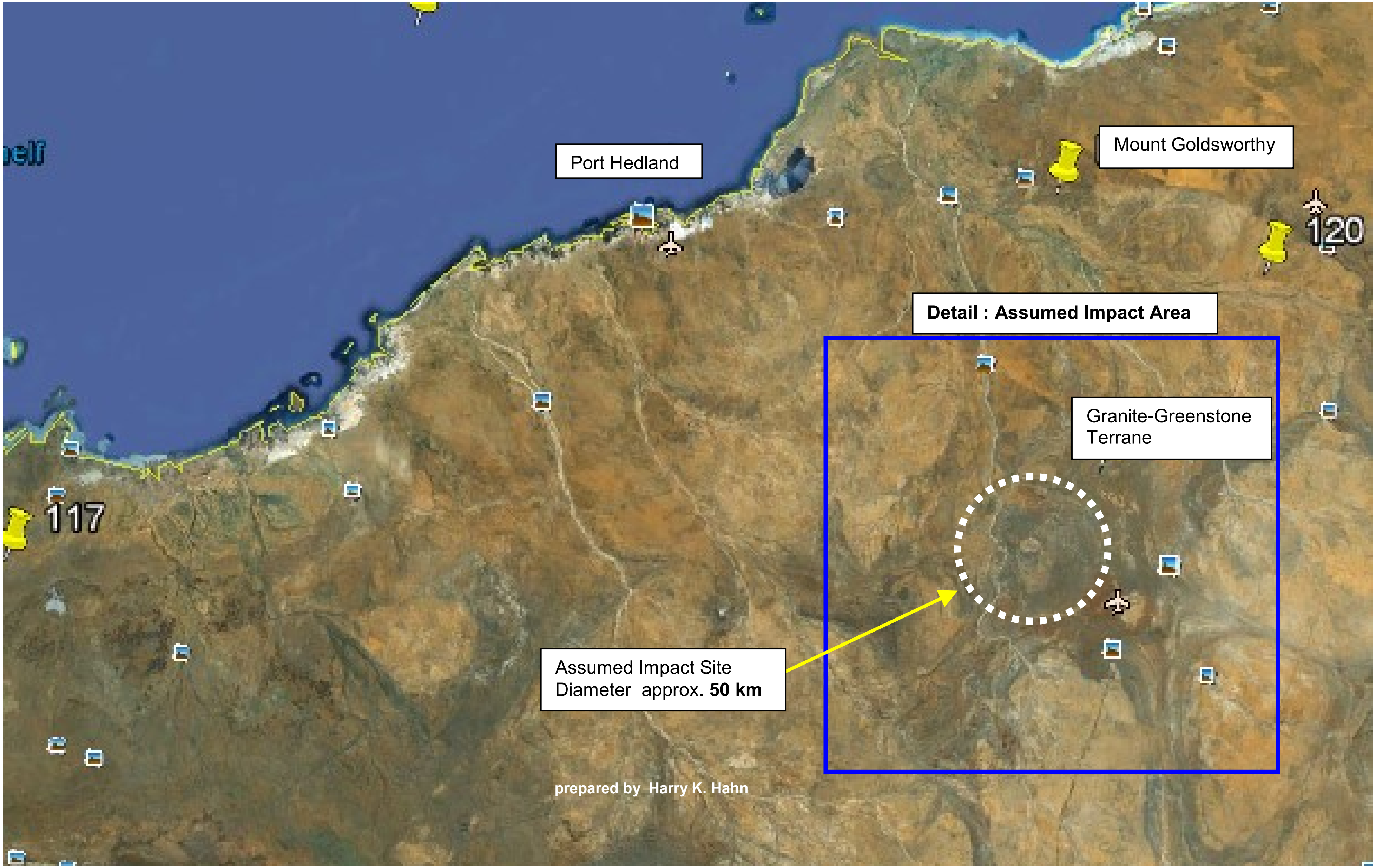
Note **circular pattern** with inner ring structure and uplift area in assumed impact (crater) zone

Total Magnetic Intensity

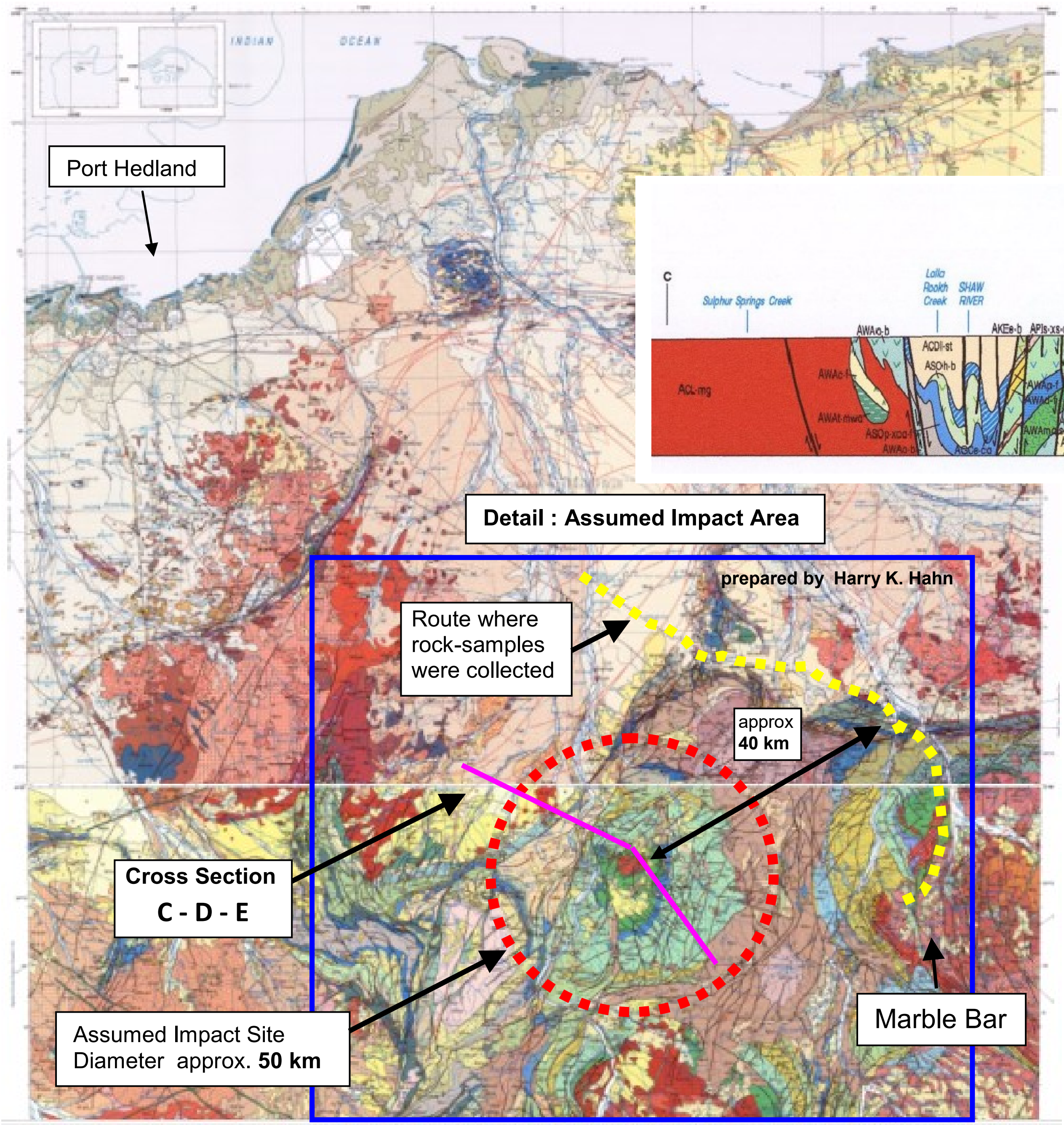


Satellite Image of the Impact Structure ∅ 50 km (age > 3 Ga) in the Pilbara near Marble Bar / Western Australia

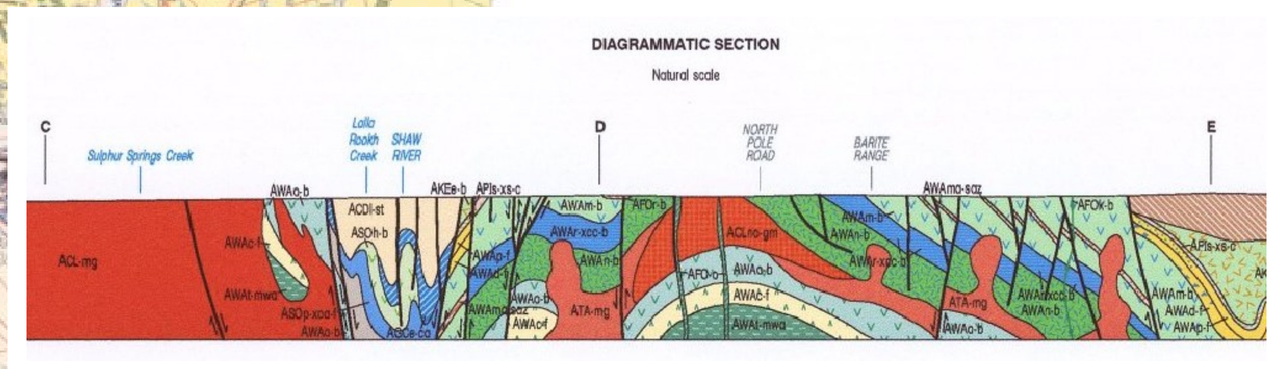
The satellite view, the magnetic intensity map & geological map indicate a very old ∅ 50 km impact structure near Marble Bar / Western Australia.
These impact structure probably was formed by a comet fragment which impacted on the indicated position approx. 3,25 Ga ago. This impact event may be connected to the BGB impact structure in South-Africa, and maybe responsible for the formation of the first life-forms on Earth around 3,25 Ga ago.



Geological Map of assumed Impact Structure with route (yellow) where rock samples where collected

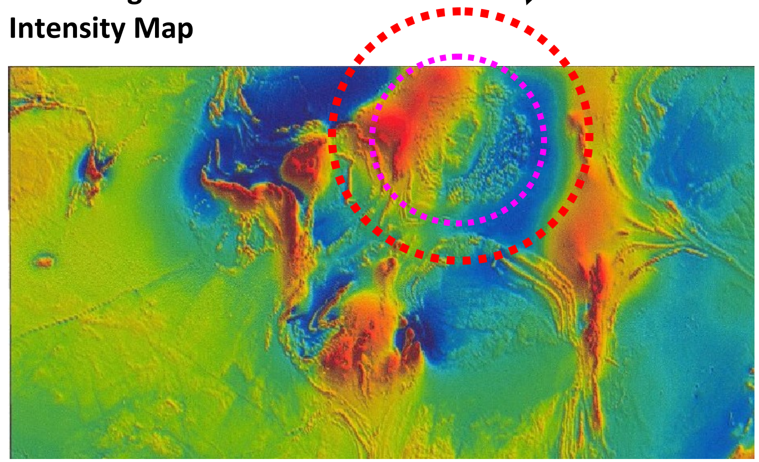


Cross-Section C – E through impact center



Note **circular pattern** with inner ring structure and uplift area in assumed impact (crater) zone

Total Magnetic Intensity Map



Geological Map of the Pilbara Granite-Greenstone Terrane

Assumed Impact Structure → Diameter approx. 50 km

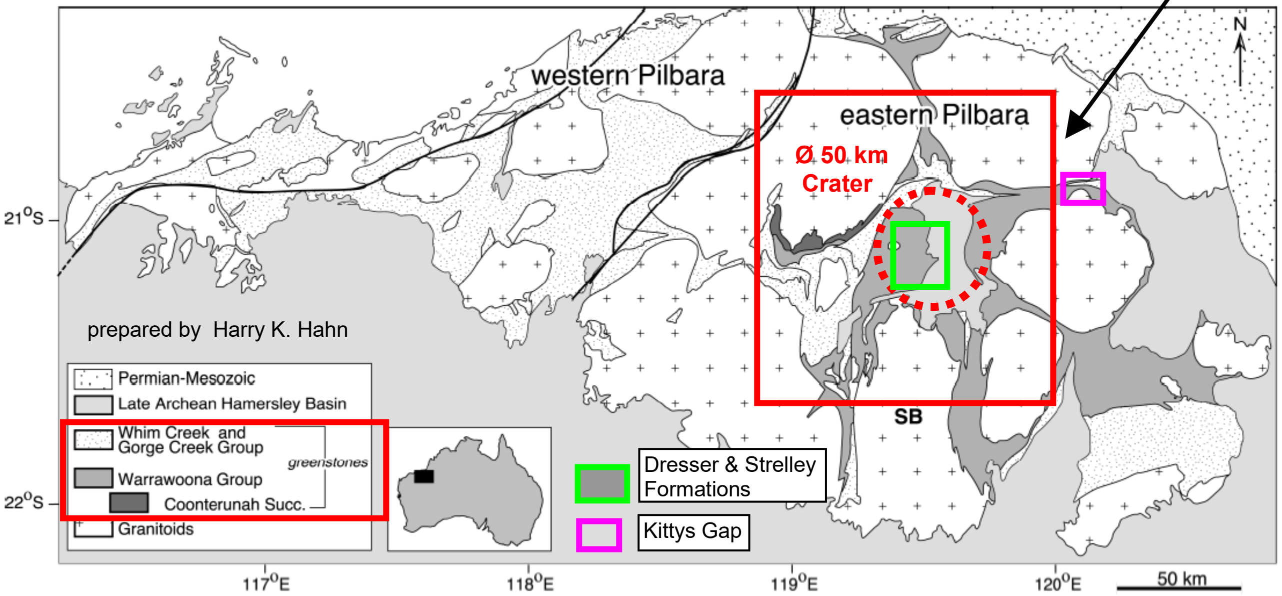
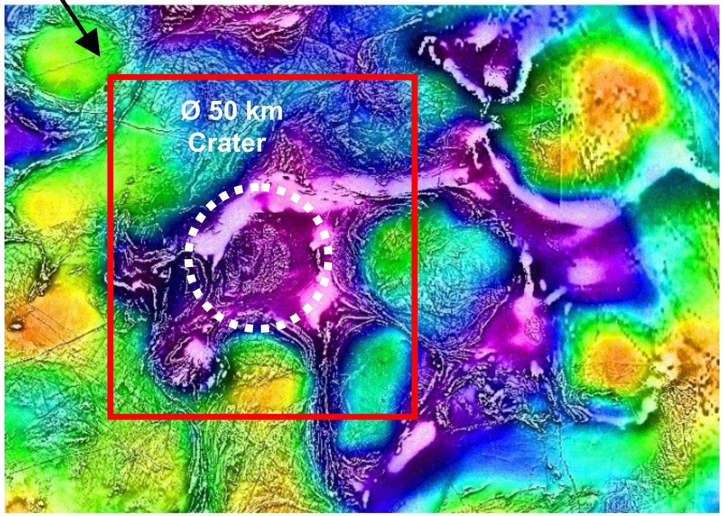


Figure 1. Geologic map of Pilbara granite-greenstone terrane. Eastern Pilbara shows typical ovoid outcrop pattern of granites surrounded by greenstone belts. Major addition of new felsic crust in eastern Pilbara occurred at 3.48–3.42 Ga, by intrusion of TTG (tonalite, trondhjemite, and granodiorite) suite granitoids and deposition of felsic volcanic rocks in Warrawoona Group. SB—Shaw batholith.



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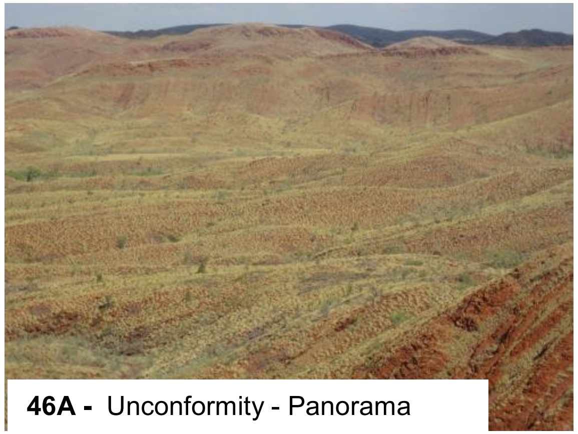
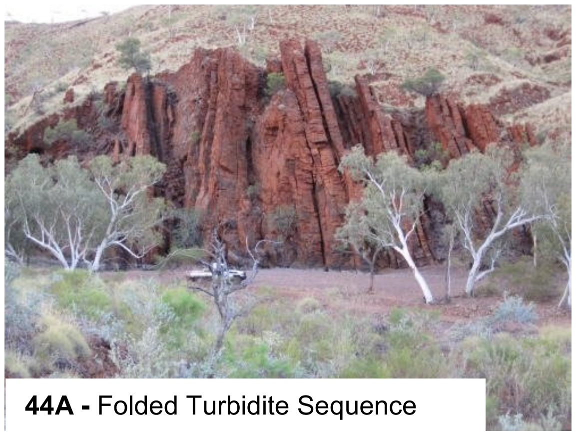


46A - Unconformity - Panorama



44A - Folded Turbidite Sequence

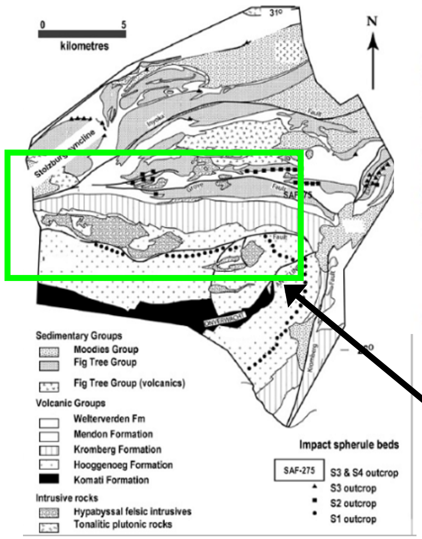
Deformed Soansville Group turbiditic sedimentary sequence unconformably overlain by Hardey Formation (Fortescue Group) of cobble conglomerate and sandstone

→ photo 46A by Carl Brauhart

Spectacular folding in turbiditic sediments of the Corboy Formation (Soansville Group). Lineation parallel to fold plunge. Lode casts. Is the outcrop in 44A an anticline? Look for sedimentary facings

→ photo 44A by Carl Brauhart

→ Geological evidence for the impact event in the Pilbara (extracts from the study “Eros-scale astroid impacts” from the geologist Andrew Y. Glikson)



Hooggenoeg Formation (& Buck Ridge complex) in BGB impact area South Africa

→ between Onverwacht Group and Mendon Formation (Moodies & Fig Tree Group)

→ see last two pages of this document regarding oldest stromatolite occurences

1. Introduction

The role of large asteroid and comet impacts as triggers of major tectonic, plate tectonic, thermal, magmatic and environmental episodes (Price, 2001; Green, 1981; Grieve, 1980; Hughs et al., 1977; Jones, 1987; Jones et al., 2002; Jones et al., 2005; Alt et al., 1988; Oberbeck et al., 1992; Boslough et al., 1994; Glikson, 2001; Glikson, 2005; Glikson, 2006; Ingle and Coffin, 2004; Ivanov and Melosh, 2003; Glikson et al., 2004a,b; Elkin-Tanton et al., 2004; Elkin-Tanton and Hager, 2005) constitutes a fundamental question in Earth science. D.R. Lowe and G.R. Byerly (Lowe et al., 1989; Lowe and Byerly, 1990) identified a juxtaposition between three 3.26 and 3.24 Ga impact ejecta/fallout units (S2, S3, S4) in the Barberton Greenstone Belt (BGB), eastern Kaapvaal Craton, South Africa, and the abrupt break between (A) 3.55 and 3.26 Ga mafic–ultramafic volcanic crust (Onverwacht Group and Mendon Formation) (Figs. 1, 2) and unconformably overlying <3.26 Ga turbidite, banded iron formation (BIF), felsic volcanic, and conglomerate-dominated continental type association (Fig Tree Group, Moodies Group), which includes the earliest observed granite derived detritus. Glikson and Vickers (2006) correlated the BGB 3.26–3.24 Ga impacts with contemporaneous stratigraphic units in the Pilbara Craton, Western Australia (Fig. 3). Here an abrupt break occurs between a 3.51–3.235 Ga mafic–ultramafic sequence (Cooterunah, Warrawoona and Sulphur Springs Groups, Pilbara Craton) and a <3.235 Ga turbidite–felsic volcanic–BIF association and overlying conglomerates (Gorge Creek Group, de Grey Group), a boundary

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Fig. 1. Geological sketch map of the SW Barberton Greenstone Belt, east Kaapvaal Craton, South Africa, showing distribution of the S1, S2, S3 and S4 Impact spherule units (Lowe et al., 2003) (courtesy D.R. Lowe and G.R. Byerly).

accompanied by multiple olistostromes overlain by siltstone and ferruginous sediments (Fig. 4). A similar break occurs in the western Pilbara Craton at ~3.27–3.25 Ga.

The significance of ferruginous argillite, jaspilite and BIF which overlie 3.46, 3.26, 3.24, 2.63 and 2.56 Ga-old impact ejecta/fallout units in the Pilbara and Kaapvaal Craton was considered in terms of changes in provenance terrains associated with tectonic and magmatic effects of these impacts (Glikson, 2006). Here I elucidate the field evidence for geodynamic episodes triggered by impacts by Eros-scale (D~30 km) asteroids in Archaean to early Proterozoic terrains, with implications for the structure and evolution of the Archaean and early Proterozoic Earth. Criteria for the identification of extraterrestrial impact ejecta units include presence of microkrystite spherules (Glass and Burns, 1988) which display inward-radiating quench textures, central-offset vesicles, relic nickel-rich spinels, high siderophile and platinum group elements (PGE) (Byerly and Lowe, 1994), high Ni/Cr and Ir/Pd ratios (Glikson, 2007) and anomalous Cr isotopic ratios (Shukolyukov et al., 2000; Kyte et al., 2003). Impact ejecta units may be conformable, transgress different facies boundaries or overlie unconformities (Lowe et al., 1989; Lowe and Nocita, 1999; Lowe et al., 2003). Quench-textured Ni-chromites (NiO<23%) with high Co, Zn and V abundances display disequilibrium crystallization and may contain nickel-rich and PGE-rich micronuggets (Glikson, 2005; Glikson, 2007). Chondrite-normalized patterns display a marked depletion in the volatile PGE species (Pd, Au) relative to refractory

Assumed Pilbara Impact Structure

Pilbara Craton

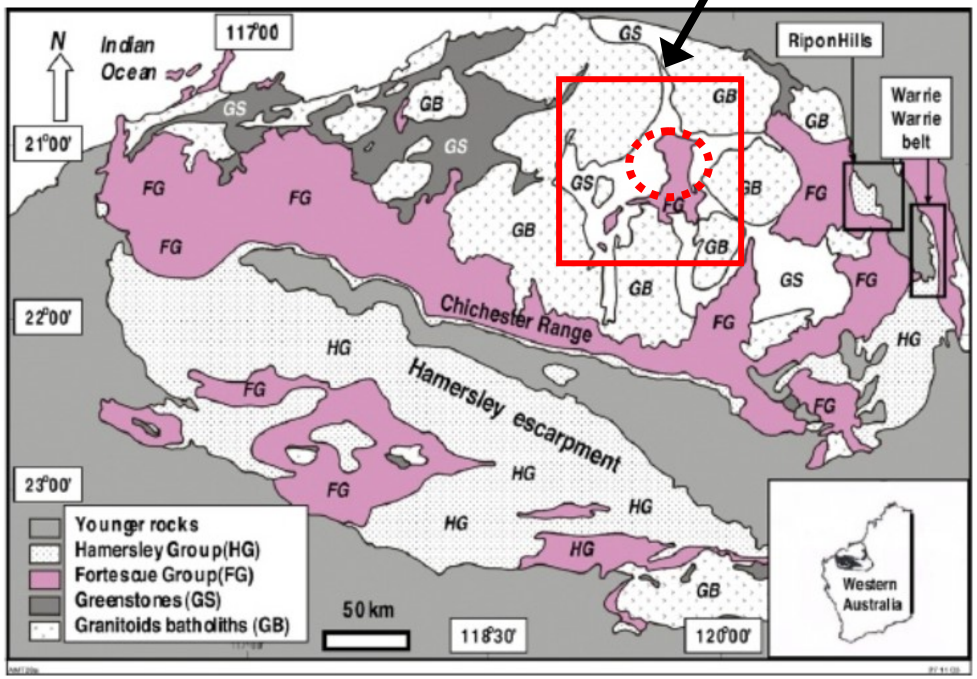


Fig. 3. Geological sketch map of the Pilbara Craton and Hamersley Basin.

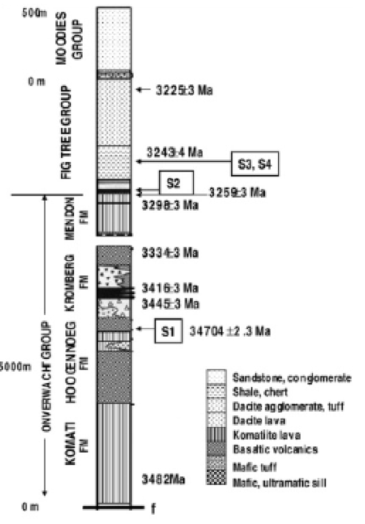


Fig. 2. Schematic stratigraphic section and isotopic ages of the Onverwacht Group and Fig Tree Group, Barberton Greenstone Belt.

species (Ir, Pt) which, excepting depleted mantle harzburgite, are distinct from terrestrial PGE profiles (Glikson, 2007). Negative $^{53}Cr/^{52}Cr$ isotopic indices correspond to values of carbonaceous chondrites and K–T boundary impact fallout unit (Shukolyukov et al., 2000; Kyte et al., 2003).

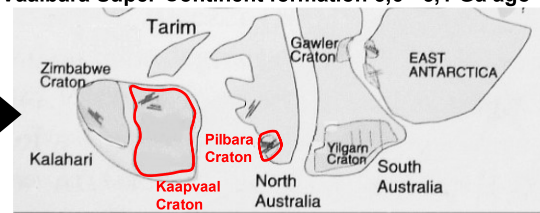
2. The 3.26–3.24 Ga impact cluster

In the Barberton Greenstone Belt (BGB), eastern Kaapvaal Craton, the ~3.26 Ga S2 impact unit coincides with the base of the clastic Mapepe Formation of the Fig Tree Group. The ~3.24 Ga S3 and S4 impact units occur within clastic sediments and felsic pyroclastics 110–120 m above the basal contact of the Fig Tree Group. In places the S3 impact unit is unconformable, cutting into underlying Mendon Formation komatiites. The ~3.26 Ga S2 impact ejecta unit is overlain by 20-to 30-m-thick banded ferruginous chert of the basal Mapepe Formation (Lowe and Nocita, 1999; Lowe et al., 2003). These iron-rich sediments, termed Manzimnyama Jaspilite Member, include oxide facies BIF, jaspilite, hematite-rich shale and shale located at lowermost stratigraphic levels of the Mapepe Formation. In the southern part of the BGB the jaspilite is either separated from the S2 unit by up to 50 m of terrigenous sediments and felsic pyroclastics, or directly overlies the S2 impact unit. In the northern part of the Barberton Greenstone Belt the ~3.24 Ga S3 impact spherule unit underlies iron-rich sediments of the Ulundi Formation, including jaspilite, ferruginous chert and black chert deposited under quiet deep-water conditions. By contrast deposition of S2 and S3 unit in the Onverwacht anticline zone, which formed an antecedent rise located between the deeper basins to the northwest and southeast, took place under high-energy shallow-water conditions, which likely precluded colloidal precipitation of iron and silica, which may account for the lack of iron-rich sediments in this sector (Lowe et al., 2003).

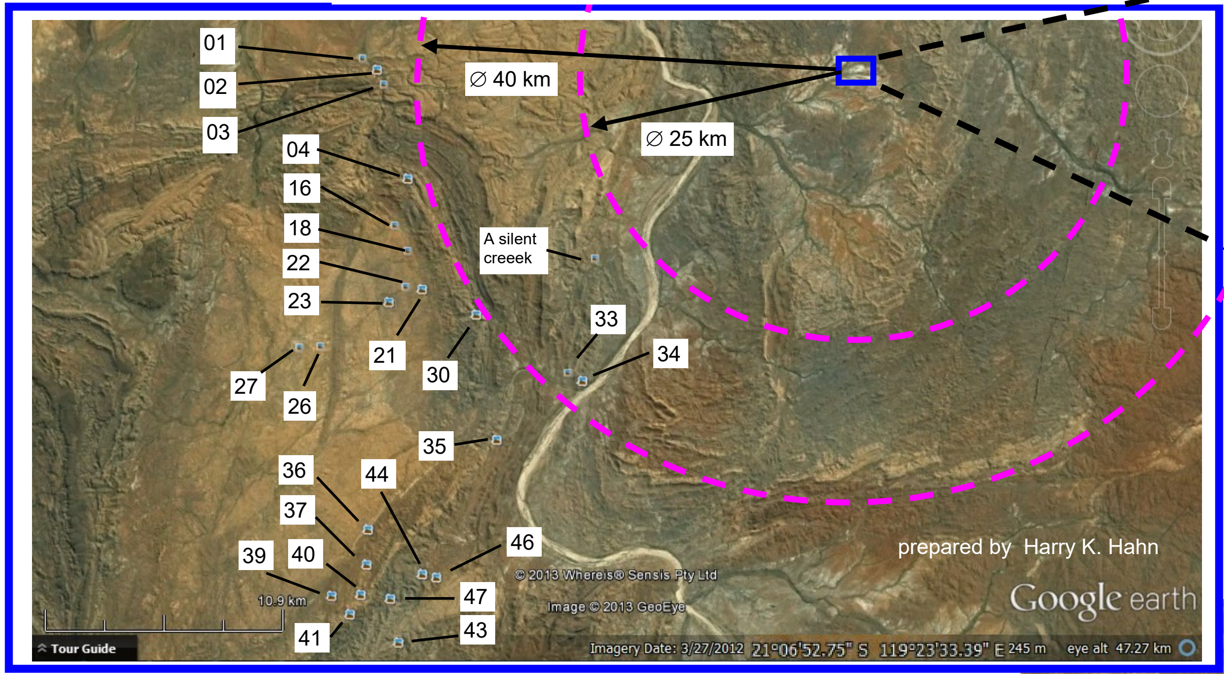
Evidence consistent with potential magmatic consequences of the Barberton impact cluster is provided by U–Pb zircon ages

Note that billions of years ago the Kaapvaal craton & Pilbara craton were close together and the BGB impact structure and the Pilbara impact structure could easily be formed by the same impact event !

Vaalbara Super-Continent formation 3,6 - 3,1 Ga ago

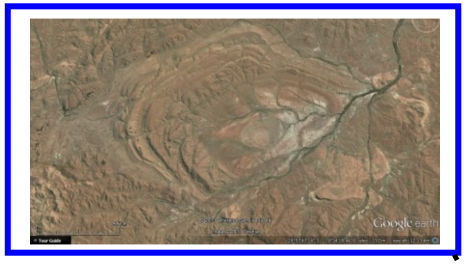


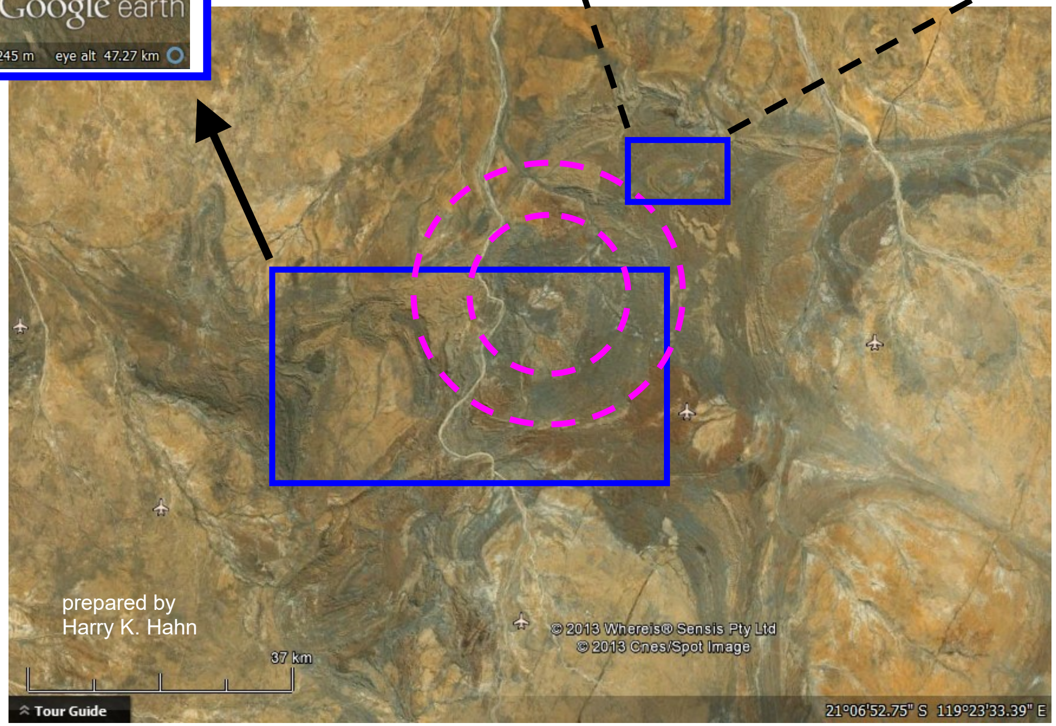
Photos from geological features near the assumed Impact Center



Mine with airstrip in the impact center (→ what kind of mine ?)

Impact Site of another fragment of impactor, or solidified magma eruption ??





Carl Brauhart (Geologist) made some photos of geological structures near the assumed impact center and put them on the Google Earth map. (→ see Google Earth)

I have numbered the geological sites according to photo numbers used by Mr Brauhart and added his photos to my documentation (→ soon on my website www.permiantriassic.de)

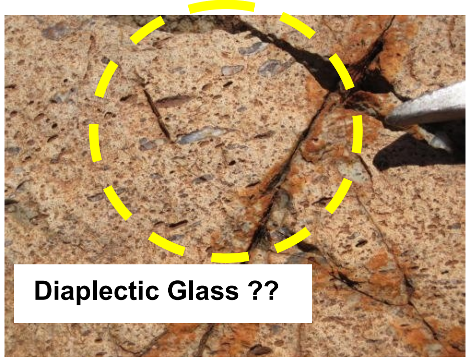
Also find some selected photos from him on the next page

Here some selected photos made by Mr Carl Brauhart (Geologist)

→ (comments to photos from Mr Brauhart)

05A : Olistostome Breccia : Debris Flow: part of the submarine mass flow that overlies the Sulphur Springs Cu-Zn depos

07A : Gossan Breccia : Siliceous gossan fragments in a matrix of ferruginous gossan: primary ore texture or weathering phenomenon?:



30C : Dacite : Amygdaloidal dacite of the Kangaroo Caves Formation. Dacite lobes with glassy margins

30D : Further Detail from site No : 30

15A : Alteration spots in Antesite : Andesite near the base of the Kangaroo Caves Formation with chlorite-carbonate-hematite spots:

15B : Detail

36A : Alteration spots in Ryholite : Chlorite-carbonate-hematite alteration spots in rhyolite (Kangaroo Caves Formation).

36B : Alteration spots in Ryholite : Further Detail from site.

08B : Siliceous Gossan: Sulphur Springs Gossan

29A : Neptunian Dykes : Upper surface of Marker Chert where cracks have been filled with overlying sandy sediment.

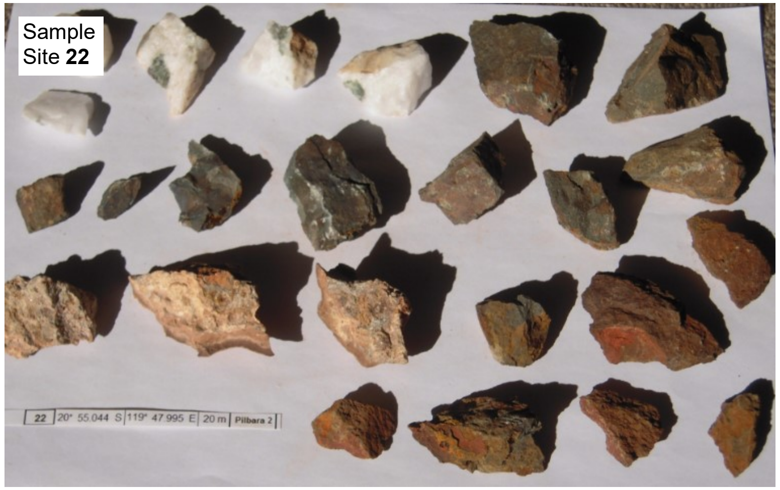
33C : Bernts Gossan : Siliceos gossan **with breccia textures** and ex-barite veins.

40C : Rhyolitic pumice breccia mass flow deposits with graded volcaniclastic sandstone tops. Nearby there are intrusions of amygdaloidal rhyolite domes

Here some photos of Rock Samples which I have collected north-east of the assumed Impact Structure

Many samples have a breccia-like appearance → (more photos of the collected rock samples on my website !)

Stromatolites found at Sample Site 20



Find more images of rock samples & sample sites under :

www.permiantriassic.de or
www.permiantriassic.at

Website will be active in April 2021 !

There seems to be a logical connection between the Pilbara Impact and some of the first live forms on Earth

As geologist Andrew Y. Glikson pointed out, there seems to be a clear correlation between the **BGB 3.26 – 3.24 Ga impact event** in South-Africa and stratigraphic units of the same age in the Pilbara Craton (→ **the assumed impact event !**).
→ **see page 3 of this document !**

There are only about 20 documented varieties of stromatolites for the period 2.8 billion years to 3.5 billion years. The oldest stromatolites found in the BGB impact area (South Africa) and in the assumed Pilbara Impact area in West Australia.

If the assumed **Pilbara Impact Event** can be confirmed then

1.) The BGB impact event & the Pilbara Crater have the **same age** and **very similar stratigraphy & sedimentary geology.**
→ e.g. see study : Sedimentary geology of Buck Ridge (South Africa) & Kitty's Gap (Western Australia)

2.) Both impact sites were originally only a few hundred km's apart (if at all !), at the time the Super-Continent Vaalbara formed.

3.) The areas where the **oldest stromatolites** on earth can be found are **less than 50 km away** from these two impact sites

4.) The oldest 3.5 Ga stromatolites are found in the Hoogenoeg Formation (Buck Ridge) / South Africa and in the Dresser Formation / West Australia, only 30 km from the impact sites.

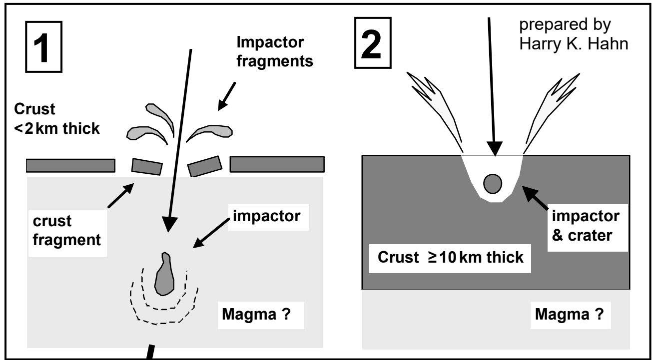
Therefore I want to propose the following hypothesis :

Both impact events, the BGB Event and the Pilbara Impact Event occurred at the same time. These impacts were caused by the same impactor, which probably was a comet, maybe coming from the Oort Cloud, which then broke apart when it reached the roche limit (approximately 10000 to 30000 km above Earths surface).
A comet would break apart in time to form multiple impactor bodies consisting of the same material, then impacting nearly at the same time but approximately a few hundred kilometers apart.
The development of the oldest known stromatolites, found very close to the two impact sites, was a direct result of these impacts !

Early at the beginning of earth's history when the planets crust was still very thin (< 2 km) an impact event was probably quite different to an impact event at a later time when the crust was much thicker (> 10 km).

The image below shall illustrate this difference. Here **image 1** shows the assumed early **Pilbara Impact event** The impactor causing a kind of bullet hole in earth's crust and releasing most of its energy below the crust in a certain distance to the entry hole.
Image 2 showing a "modern impact event" were in contrast all of the energy is released on the surface.

An impact event as shown in image 1 would have allowed some parts & ingredients of the impactor to survive the impact event relatively undamaged !
In this way ingredients of a comet : e.g. water, ammonia, methane, carbon monoxide, hydrogen cyanide or even amino acids or bacteria would have arrived on earths surface fully intact ! This "seed material" together with the heat coming from below could then have formed the ideal base for the development of the first stromatolites !



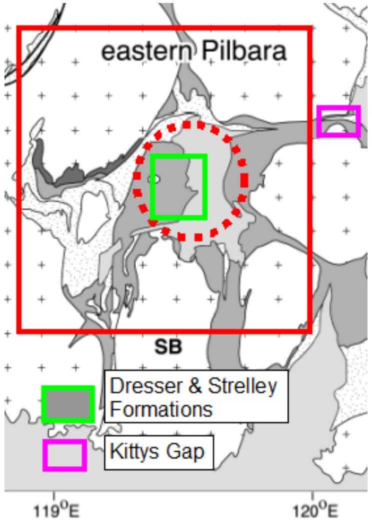
Like a bullet crashing through a thin glass plate the impact leaves a star-shaped crack pattern with some loose fragments around the hole.
→ **compare with the maps shown on page 3 & 4 of this document**. The entry hole or "impact crater" only around 2 – 5 times bigger than the impactor.

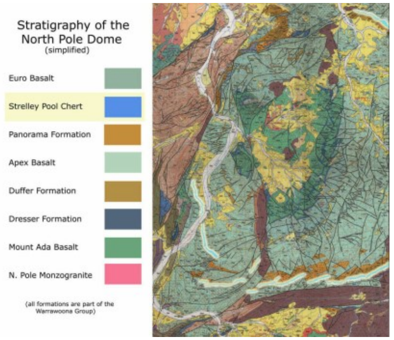
Photos from Mr Carl Brauhart :

34A : Stromatolites : Laminated algal carbonate unit which is partly silicified. Domal stromatolites

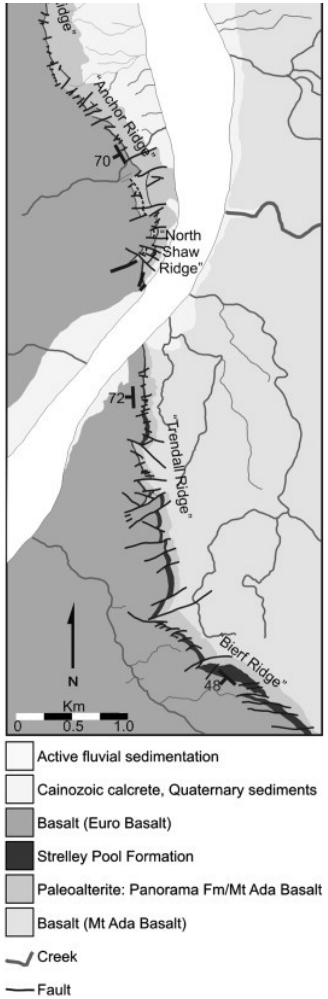
The Hoogenoeg Formation (Buck Ridge) / South Africa and the Dresser Formation / West Australia are the locations were the oldest stromatolites on Earth can be found :

Overview Map



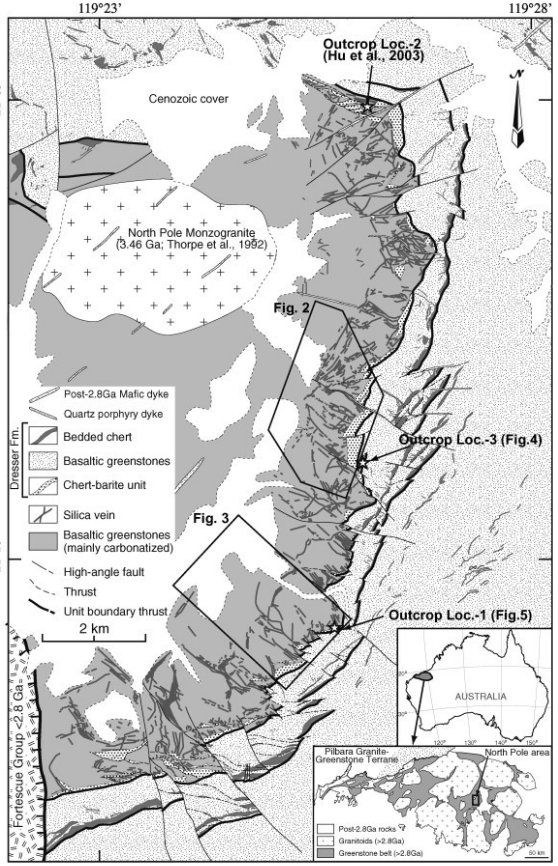


North Shaw Ridge
(Strelley Formation)



The 3.43 billion-year-old Strelley Pool Chert, Pilbara Craton, Western Australia, contains compelling evidence of Early Archaean life in the form of kilometre-sized remnants of an ancient stromatolitic carbonate platform. Both vertical and lateral trends show that stromatolite abundance and diversity are greatest in the area interpreted as an isolated, partially restricted, peritidal marine carbonate platform, or reef, where there is virtually no trace of hydrothermal or terrigenous clastic input. In contrast, stromatolites are poorly developed or absent among hydrothermal, volcaniclastic or terrigenous clastic sedimentary facies, and are absent in deeper marine settings that are laterally equivalent to shallow marine stromatolitic facies.

Dresser Formation



Growth-fault structure and stratigraphic architecture of the Buck Ridge volcano-sedimentary complex, upper Hooggenoeg Formation, Barberton Greenstone Belt, South Africa

Abstract

The ~3.45–3.42 Ga Buck Ridge volcano-sedimentary complex (BR-vsc) forms the uppermost part of the Hooggenoeg Formation, in the early Archaean Onverwacht Group of the Barberton Greenstone Belt, South Africa. The complex consists mainly of massive and pillowed basalts and felsic, quartz-plagioclase porphyritic rocks, which are capped by pervasively silicified sedimentary rocks. Deposition of the felsic extrusive and (volcani-)clastic sedimentary rocks occurred in shallow water to emersion, during an extensional tectonic regime. The extensional regime is expressed by a number of listric normal faults that transect the entire ~2 km thick complex. The syndepositional (i.e. growth fault) character of the faults is indicated by variations in thickness and facies of rock units across the faults, and by systematic rotation of the fault blocks. Broadly contemporaneous with the faulting, felsic rocks intruded the complex into the highest levels. The geometry of these intrusive bodies was controlled by the major growth faults. Extension also created space for the intrusion of approximately bedding-perpendicular felsic and mafic dykes, and black chert veins. The new field observations and U–Pb zircon SHRIMP data have pinned the timing of events during and after deposition of the BR-vsc. The growth-fault model accounts well for previously unexplained structural observations that include both extensional and compressional features. Recognition of an early extensional phase of deformation demonstrates further similarities between the tectonic histories of the Barberton Greenstone Belt and the greenstone belts of the east Pilbara in Australia.

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Sedimentary geology of the Palaeoarchaean Buck Ridge (South Africa) and Kittys Gap (Western Australia) volcano-sedimentary complexes

The two Palaeoarchaean volcano-sedimentary complexes of the Buck Ridge (Barberton Greenstone Belt, South Africa) and Kittys Gap (Coppin Gap Greenstone Belt, East Pilbara, Australia) have a similar geological setting and age (~3.45 Ga). The predominantly volcaniclastic sediments are concentrated at the top of these complexes, and experienced thorough, (very) early diagenetic silicification. In many places the silicification process has led to excellent preservation of the primary sedimentary structures. Elsewhere it has resulted in their obliteration or replacement by diagenetic structures. The Buck Ridge chert forms a regressive-transgressive succession, deposited around base level, with lacustrine and littoral marine facies. Deposition of the Kittys Gap Chert was also close to base level, almost exclusively subaqueous, with tidal influence and a regressive sequential trend.

In both volcano-sedimentary complexes, these low-energy sediments are juxtaposed with high-energy breccia pods and layers, with often a high Fe-oxide content. The breccias are interpreted as being the result of explosive hydrothermal activity. Sedimentation was strongly controlled by normal faulting.

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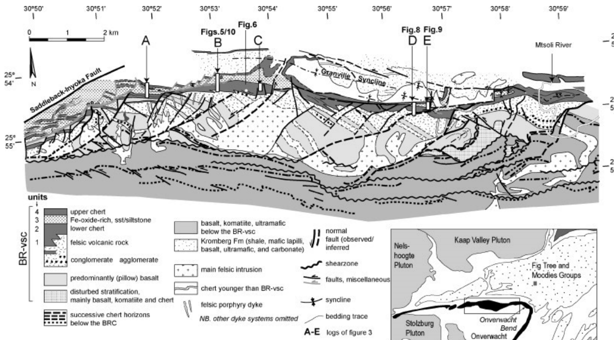

Fig. 1. Geological map of the Buck Ridge volcano-sedimentary complex in the upper Hooggenoeg Formation (map simplified after 0050 and 0185; for location in the southern Barberton greenstone belt see the inset). The entire succession has been tilted into a vertical orientation; younging direction is to the north. A–E refers to log locations. Locations of Fig. 5, Fig. 6, Fig. 8, Fig. 9 and Fig. 10 are indicated. Legend applies to the main figure, not to the inset.

log of figure 11

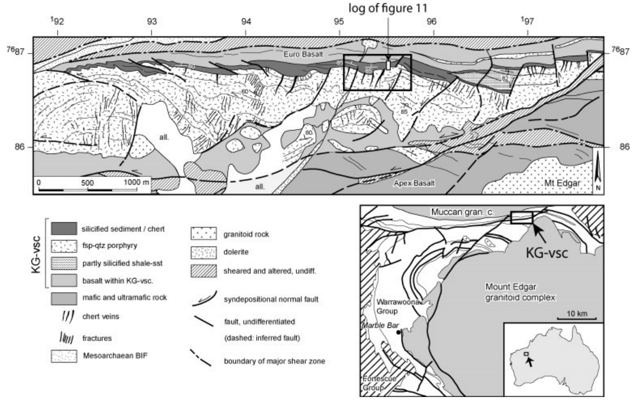

Fig. 2. Geological map of the Kittys Gap volcano-sedimentary complex (KG-vsc; Panorama Formation; map after De Vries et al., 2006b). The main study area is indicated by a rectangle; the location of figure within the Coppin Gap Greenstone Belt is indicated in the inset. Legend applies to the main figure, not to the inset. Map grid is Australian Map Grid, Zone 51K.

References :

Part 5 of my Study : Global Impact Events are the cause for Plate Tectonics and the formation of Continents and Oceans_Part 5

Part 1 : The 1270 X 950 km Permian-Triassic Impact Crater Caused Earth's Plate Tectonics of the Last 250 Ma

Part 2 : The Permian-Triassic Impact Event caused Secondary-Craters and Impact Structures in Europe, Africa and Australia

Part 3 : The Permian-Triassic Impact Event caused Secondary-Craters and Impact Structures in India, South-America and Australia

Part 4 : The Permian-Triassic Impact Event and its Importance for the World Economy and for the Exploration- and Mining-Industry

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