OF PLATES, PLUMES AND PROFESSORS

TO KNOW WHERE WE ARE GOING, WE NEED TO KNOW AND RESPECT OUR PAST, BOTH OUR GEOLOGICAL HISTORY AND THAT OF THE DEPARTMENT

In this talk I plan to cover four topics:

(1) the history of the Department (a cyclicity of "plumists and platists")
(2) the history of the early Earth (cf. "plates and plumes")
(3) the history of our surroundings at UP and its hinterland (cf. craton, basins and plumes)
(4) the present state and future plans of the Department (plumes and plates forever)

PART ONE: THE HISTORY OF GEOLOGY AT UP

THE PAST:
one possible view

1908: UP's total student and staff complement – some things have changed

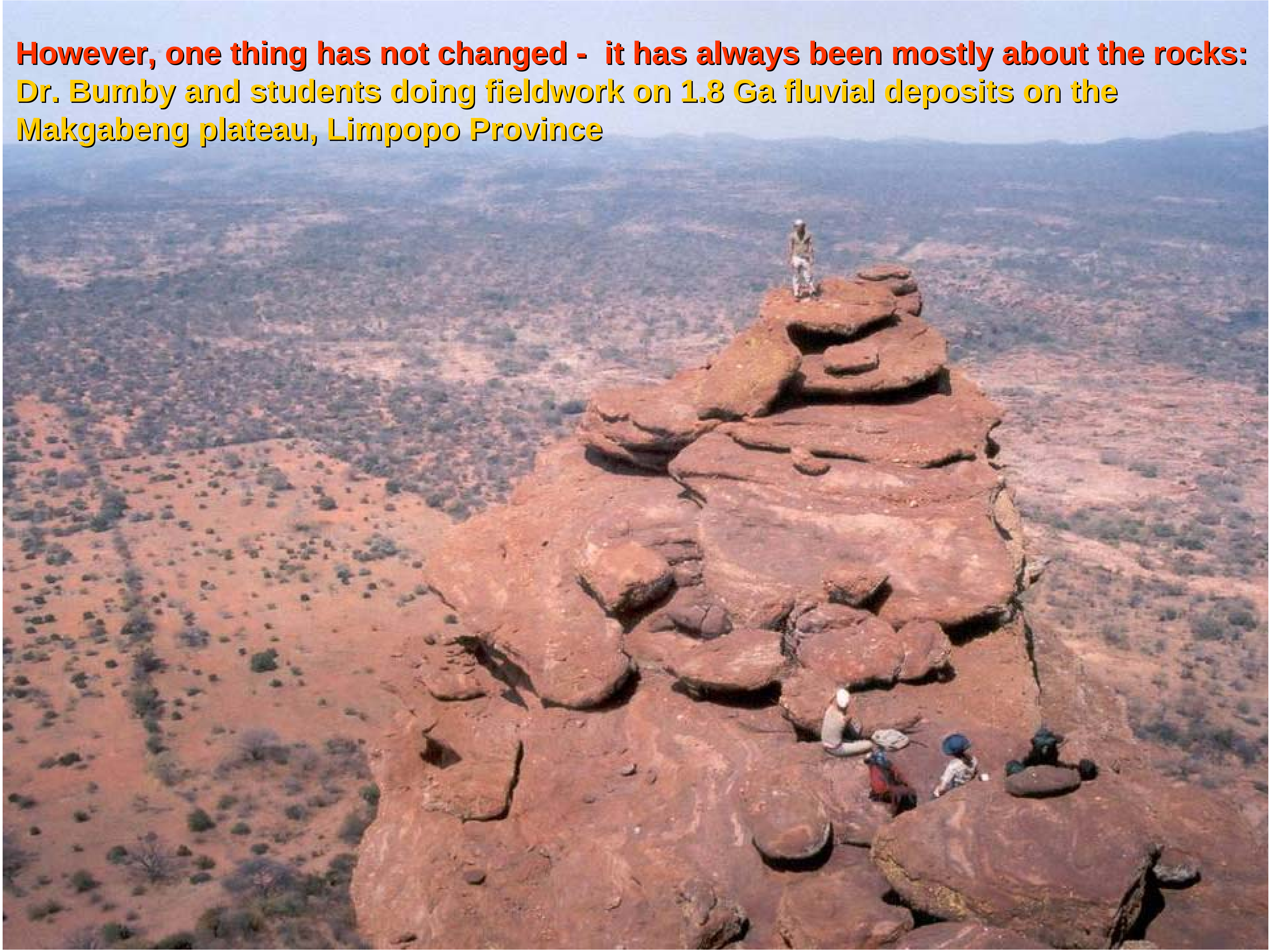
70 years later, the staff (of Geology) was looking a little bit happier, but that probably only reflects their improved salaries

1990's – and salaries just continued to improve (except, apparently, for the guys in the front row)

Excursions have always been a lot of fun for all; pre-petrol-price-worry transport

Professor in action during river crossing practical

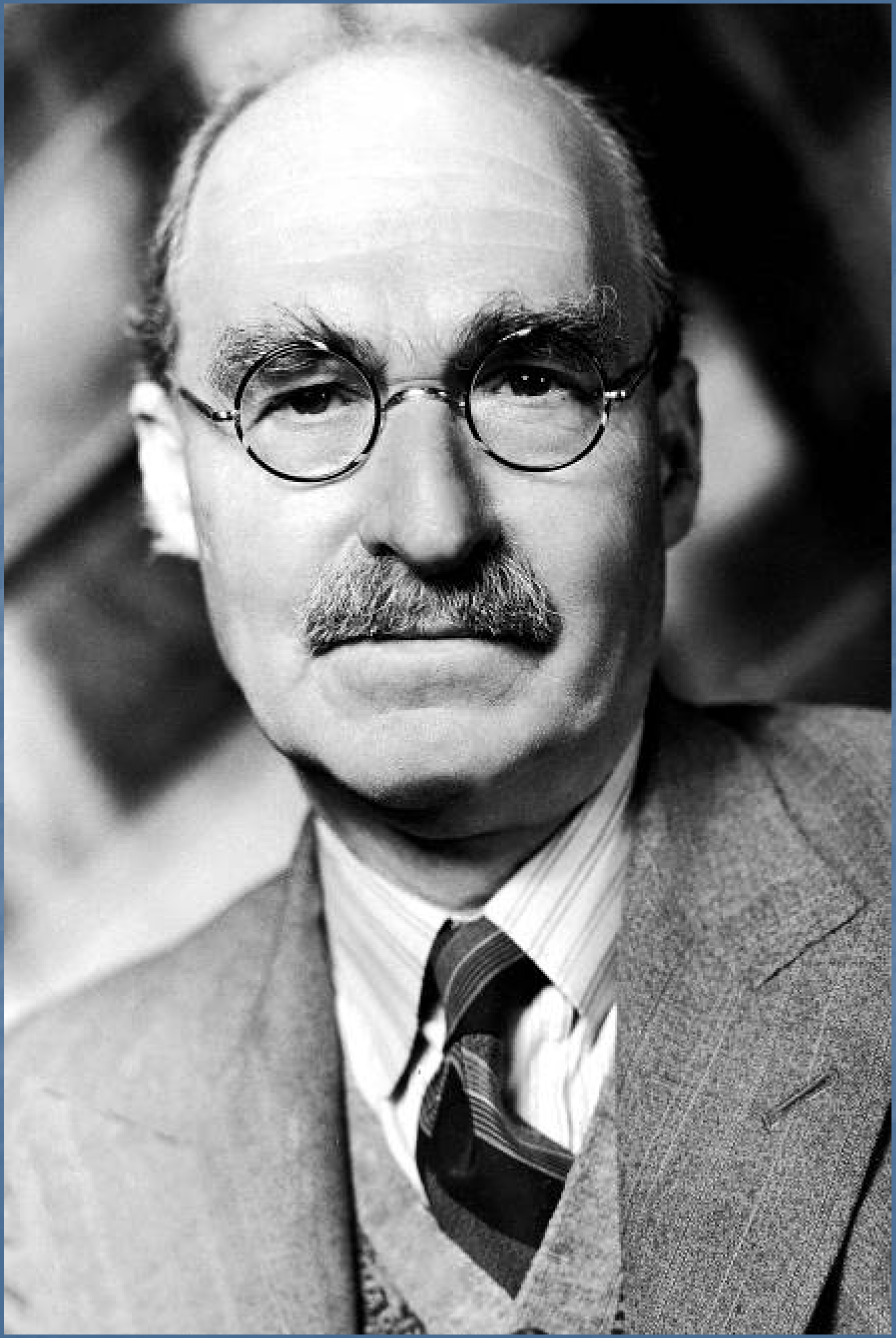
Sometimes, modern transport doesn’t help, nor do the ladies or the Professor


However, one thing has not changed - it has always been mostly about the rocks:
Dr. Bumby and students doing fieldwork on 1.8 Ga fluvial deposits on the
Makgabeng plateau, Limpopo Province

UP GEOLOGY: PAST - the history of the Department (a cyclicity of “plumists and platists”)

In 2008, the University of Pretoria and its Department of Geology will be 100 years old; it is thus fitting to take a look back before venturing a glance at the future

UP staff and students, 1908

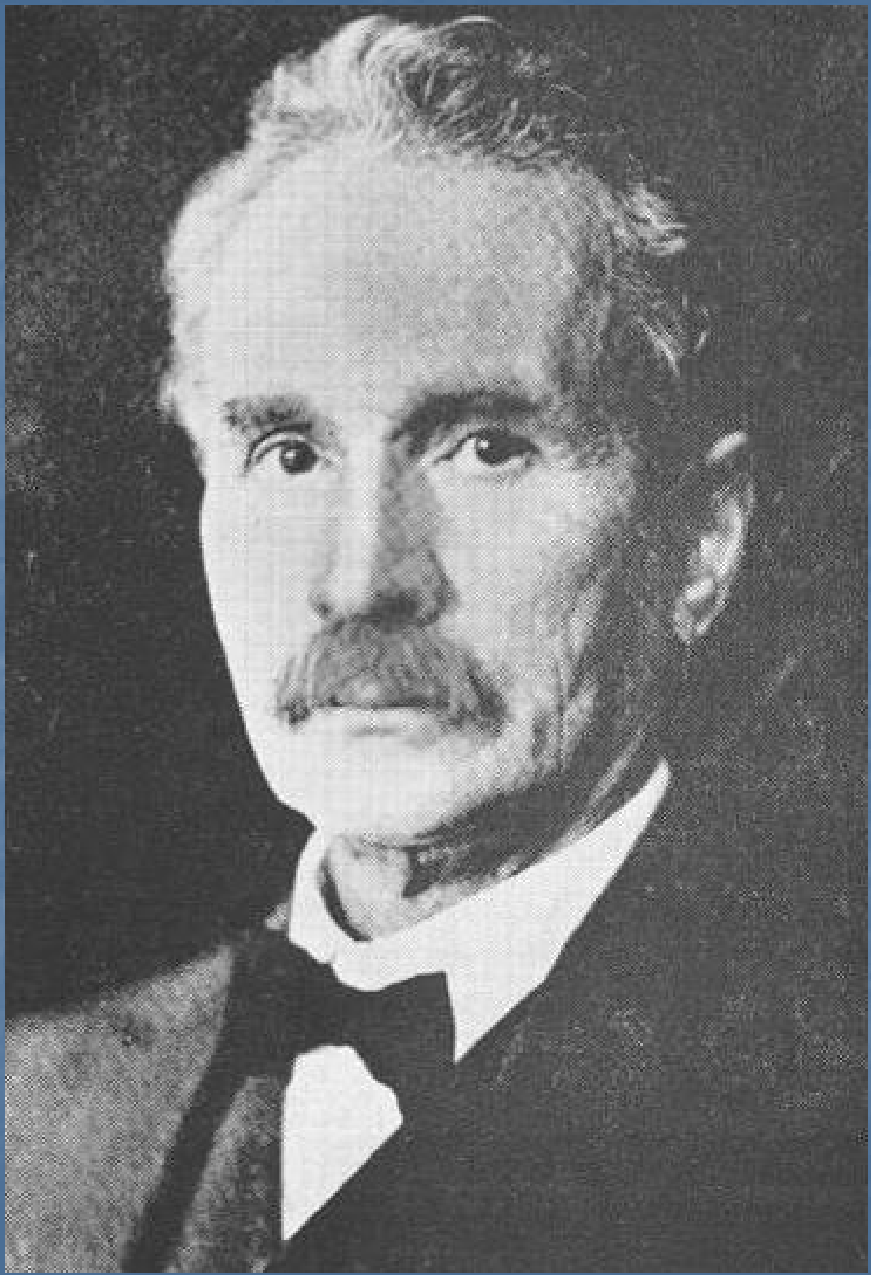


Prof. du Toit Malherbe

First “Head” of Geology
(and Maths and Chemistry)
at UP, 1910-1920

Dié professor het dus
‘n “leer-rusbank”
bekleë.

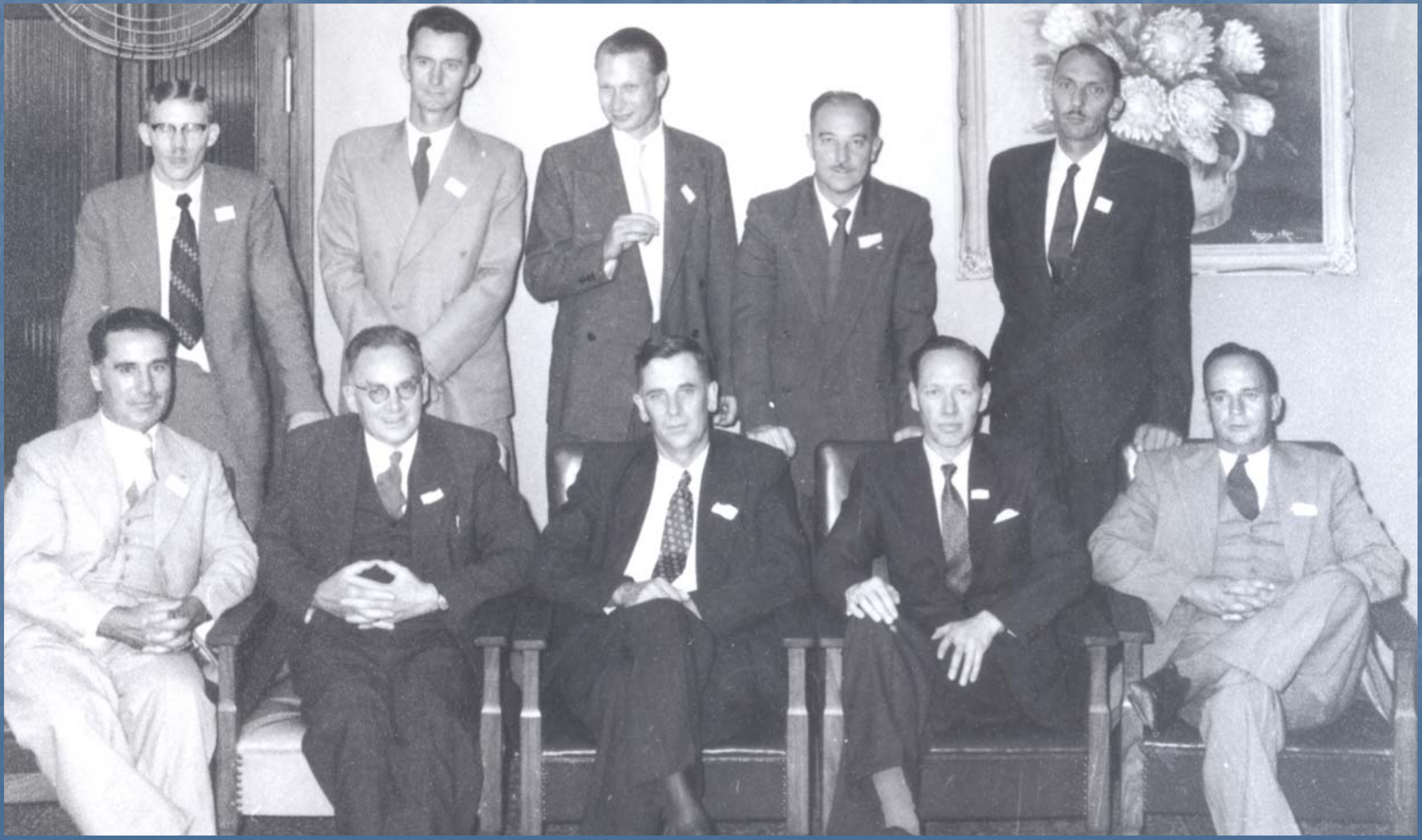
Jan F Celliers, the famous SA poet, brother of Izak Celliers, our second lecturer, who also donated the money for the Jan F Celliers bursary (ca. 1910-11), which is still awarded every year

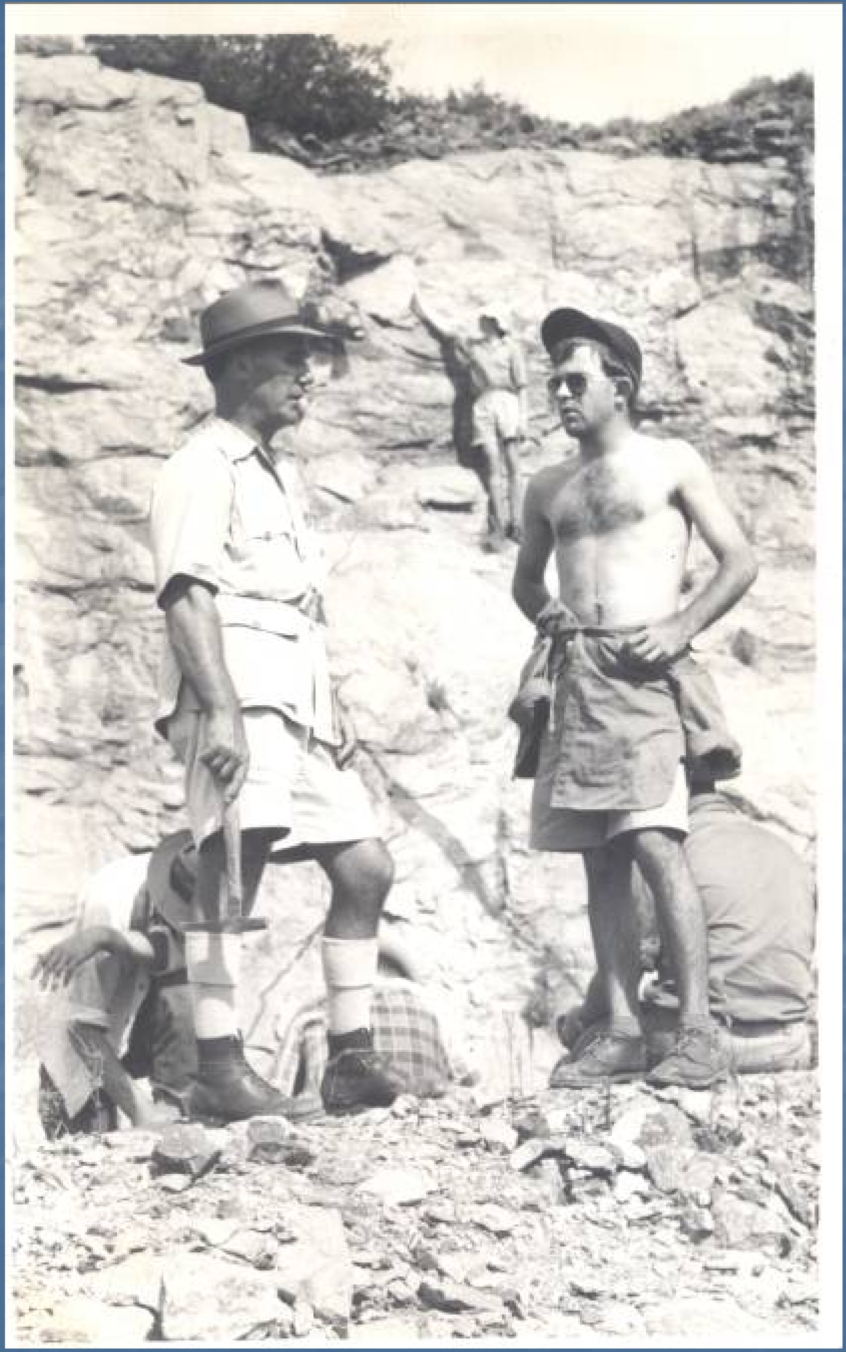


Prof. L.C. de Villiers, first head, *sensu stricto,* of Geology (1920-1947)

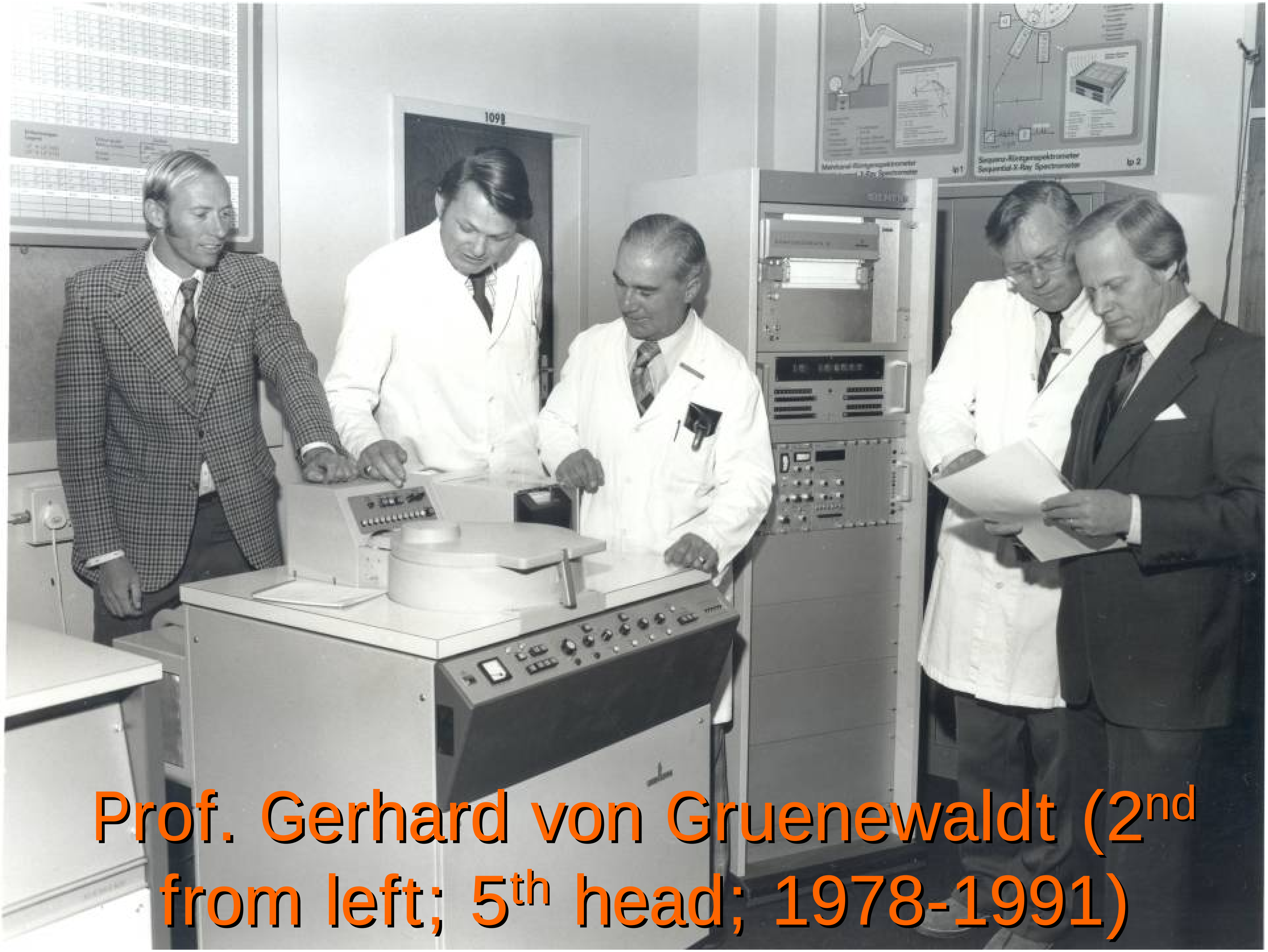

Prof. Ben Lombaard (second head; 1947-1952)

Staff and alumni, with third head, Prof. "Mackie" Willemse (centre, front; 1952-1967)

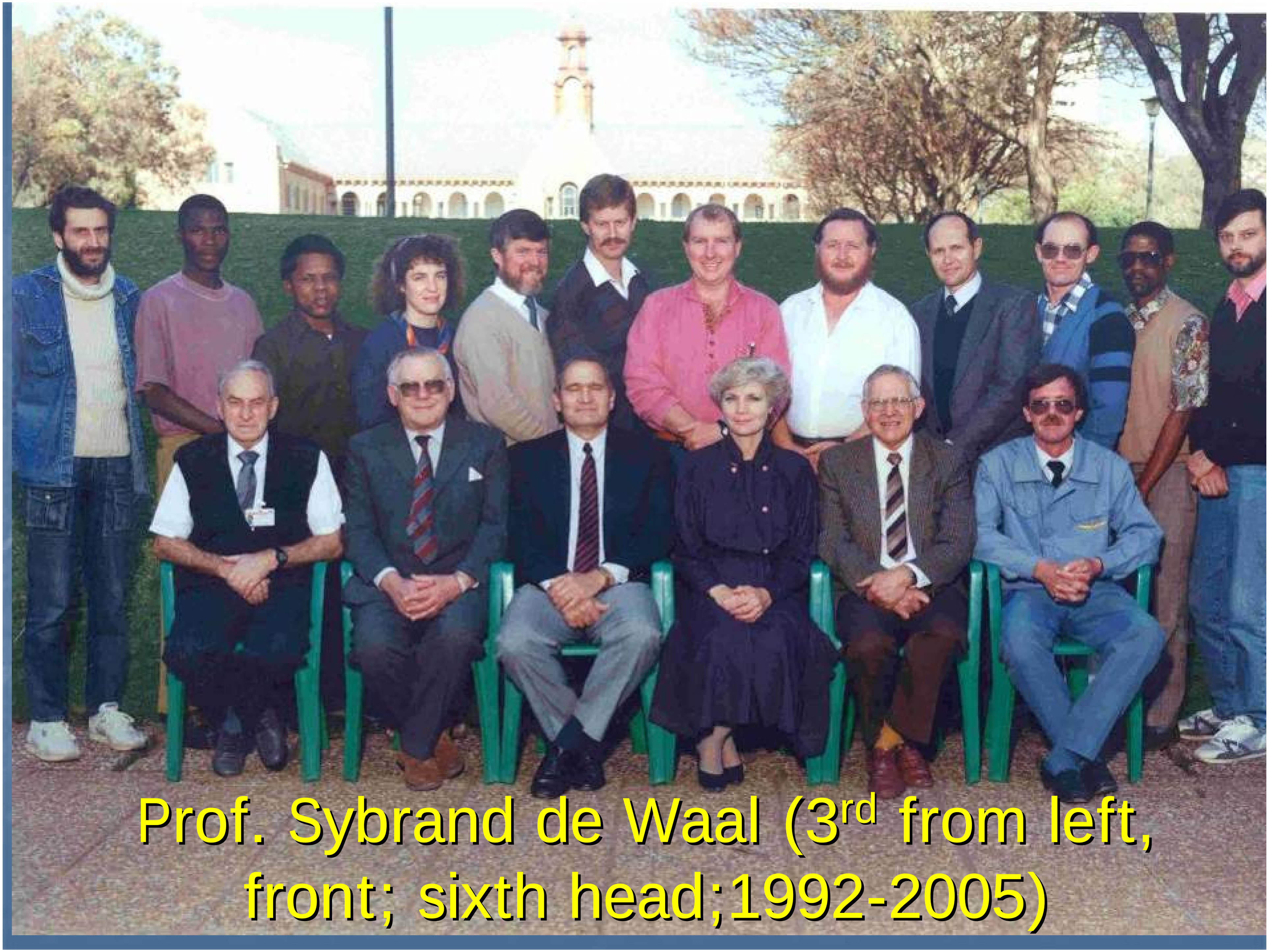




Prof. Dirk Visser, 4th head (1967-1977)



Prof. Gerhard von Gruenewaldt (2nd from left; 5th head; 1978-1991)



Prof. Sybrand de Waal (3rd from left, front; sixth head;1992-2005)

"NATURAL CYCLICITY" OF THE HEADS

There has been an almost geological cyclicity of the heads of Geology at UP, with alternations of "plumists" with "tectonicists":

- LC de Villiers (1920-1947) – tectonics and stratigraphy
- Ben Lombaard (1947-1952) – Bushveld Complex
- Mackie Willemse (1952-1967) – Bushveld Complex
- Dirk Visser (1967-1977) – tectonics and sedimentology
- Gero von Gruenewaldt (1978-1991) – Bushveld Complex
- Sybrand de Waal (1992-2005) – Bushveld Complex
- Pat Eriksson (2006-) – sedimentology and tectonics

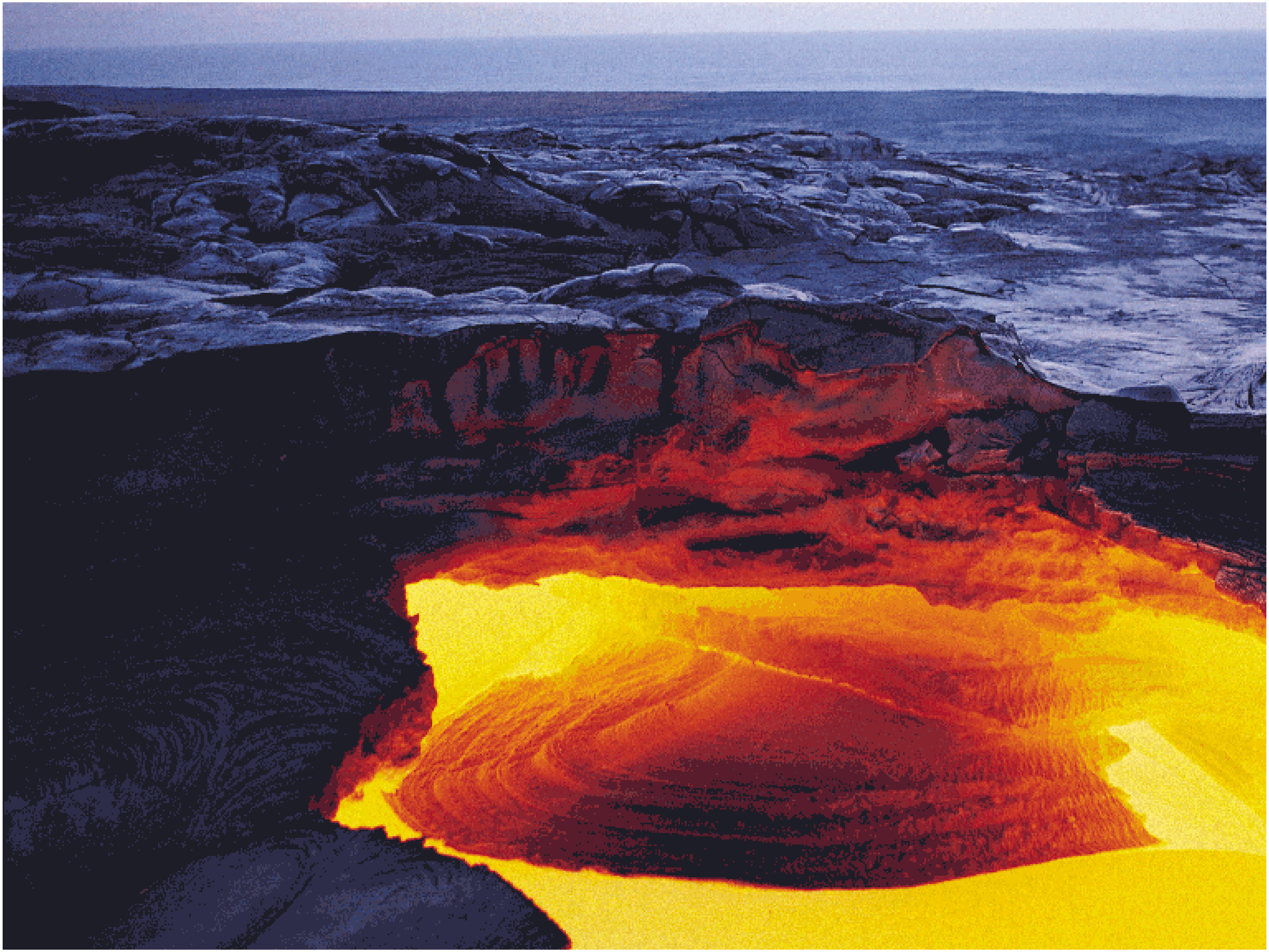
PART TWO: THE HISTORY OF THE EARLY EARTH – PLATES AND PLUMES

The history of the early Earth (cf. “plates and plumes”)

- The Earth is a complex, living “organism” (the Gaia hypothesis) that is constantly changing, mostly on a cyclical basis. These natural systems are critically important for the health and survival of the entire Earth-system, but they bring dangers at local levels and short (i.e. human) time scales, that affect all living creatures, ourselves included.
- Volcanism is an example of such a natural system. Without it, continents would never have been formed nor would life have begun. However, volcanic eruptions can cause untold harm to our man-made and natural world – is this God’s fault? – no, it is our’s – the fault, if any, lies in our imperfect understanding of Earth and its natural systems, and in our unwillingness to apply fully our existing knowledge, and in letting economic and social factors over-ride our own good scientific sense.
- Plate tectonics is intimately related to volcanism as are plumes – many plumes result in what are called flood basalts or volcanic island chains (e.g., Hawaii) at the Earth’s surface. Plates and plumes are thus intrinsic in these first-order natural systems and the effects they have on our lives.

VOLCANOES:

During an eruption, magma may flow out of the Earth and over the surface as lava, or blast into the air as ash



Fountain Eruption, Hawaii
A 300m high fountain of basaltic lava erupts from Mauna Ulu in 1969.


Basaltic pahoehoe flow (ropey texture)


Lava as a hazard


Drakensberg basalts, Lesotho

Volcanoes as Hazards:

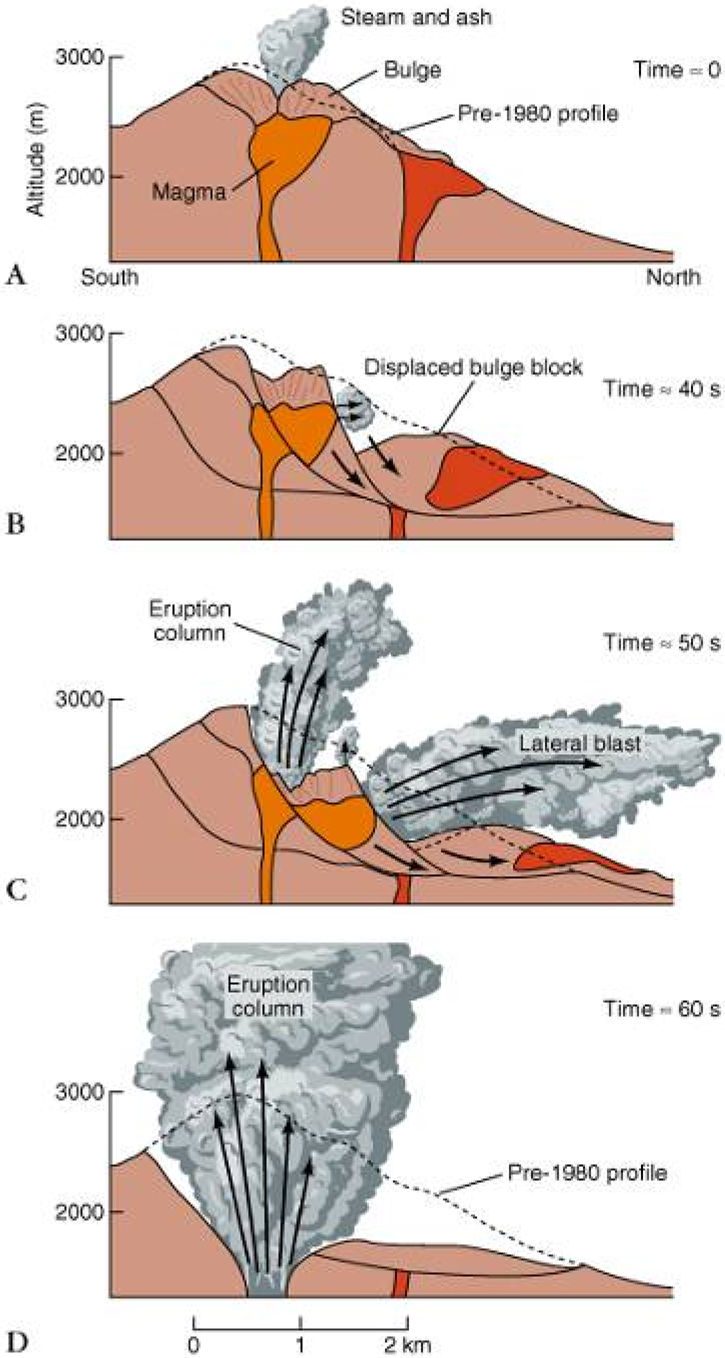
Volcanic activity has given us:

1. Crustal rocks
2. Fertile Soils
3. May have led to earliest life forms ("black smokers")
4 Remote volcanic islands lead to enhanced biodiversity
5. Minerals and energy resources often intimately associated with volcanism and igneous activity

BUT….!

Mount St. Helens: May 18th 1980

Less than 60 seconds later



Sudden depressurisation of andesitic magma at Mount St. Helens

Threat of landslides:

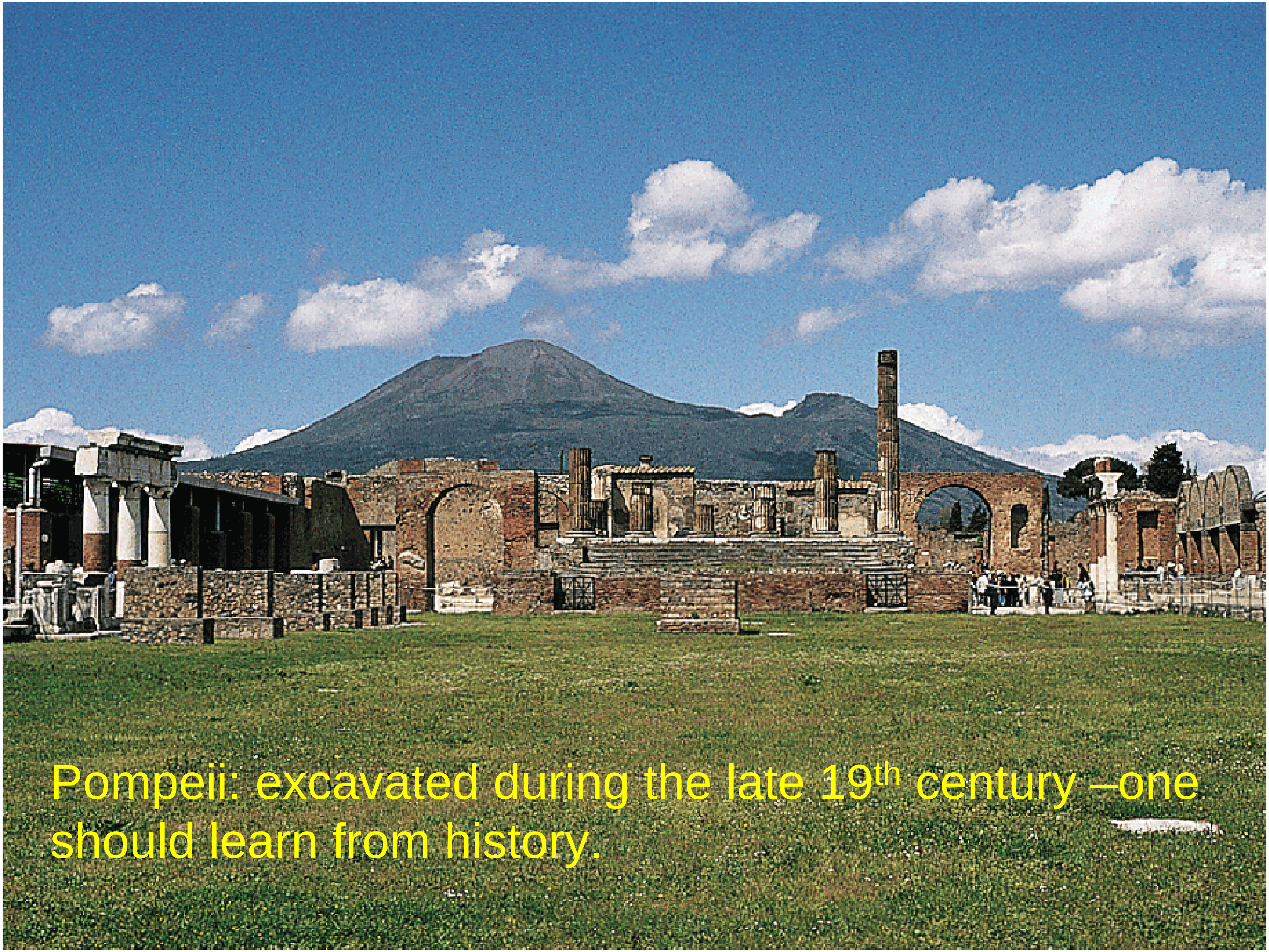
During the eruption of Mt. St. Helens in 1980, 8 billion tonnes of debris slid down the mountain, over a ridge and into river valleys, and came to rest 20 km away from the volcano. They can move up to 250 km/h


Lahar deposit (Mt. St. Helens)

Ignimbritic (ash-flow) eruption in Japan – fire truck being overtaken by pedestrian


Beautiful, yes; but, is this wise?

An act of God, certainly, but the danger inherent in the location is an entirely human failing


Pompeii: excavated during the late 19th century –one should learn from history.

If only I had attended those Geology 101 lectures at UP, instead of studying economics at UJ, this would never have happened....

The importance of basalt: for plumes and plates

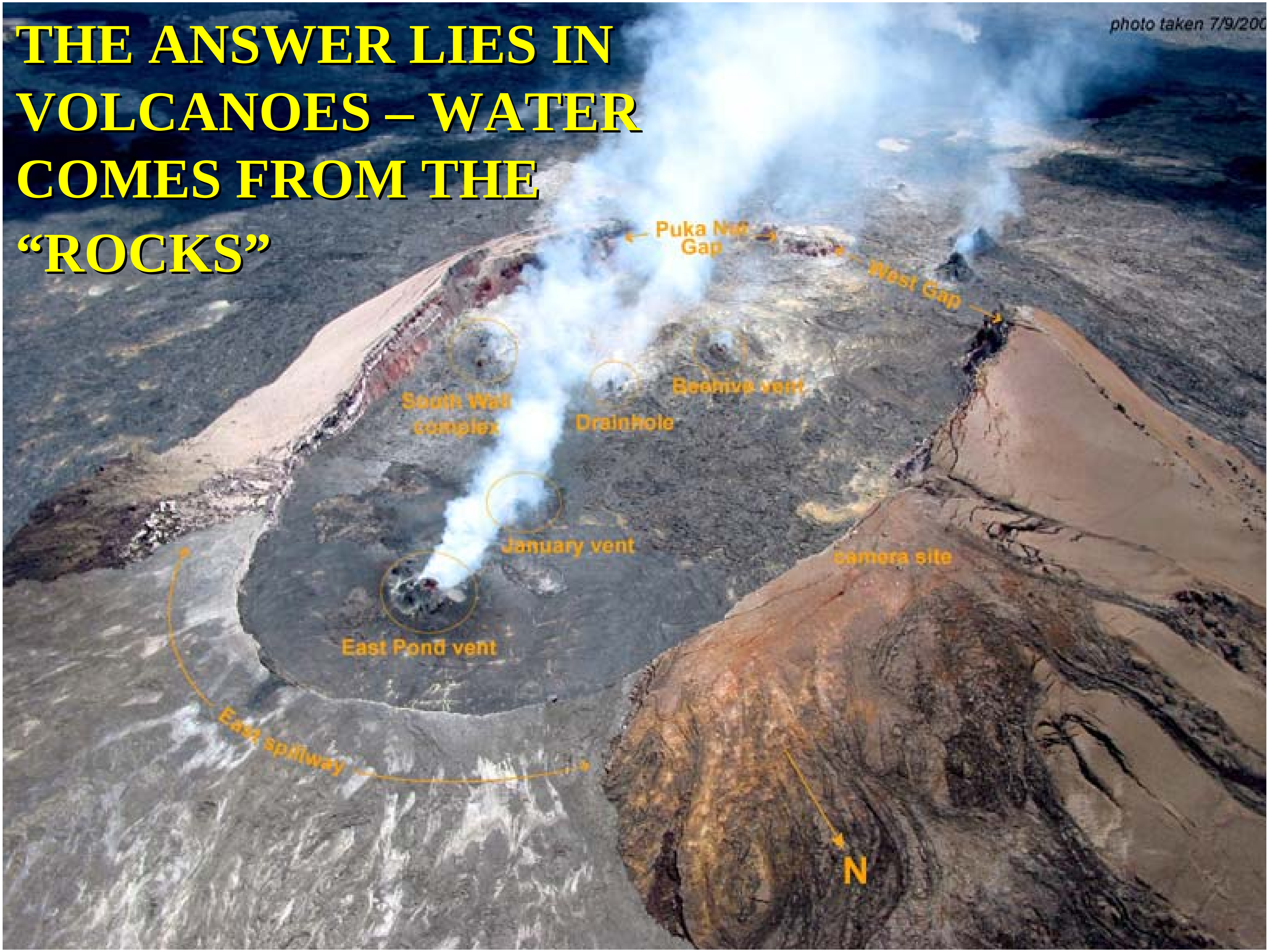
- In many ways, basalt is the life blood of the Earth:
- – it is the essential building block for continental crust (cratonic plates)
- - it's eruptive products formed the Earth's atmosphere
- - it is almost intrinsic in mantle plumes impinging on continental plates


EARLY EARTH ORIGINALLY HAD
ONLY MOLTEN ROCKS AT SURFACE

WE ALL KNOW THAT WATER ON EARTH COMES FROM RAIN, AND THAT RAIN, ON THE GLOBAL SCALE, IS DERIVED FROM EVAPORATION OF SEA WATER.

BUT, WHERE DID THE WATER ORIGINALLY COME FROM?

THE ANSWER LIES IN VOLCANOES – WATER COMES FROM THE "ROCKS"



ABOUT 70% OF THE ERUPTIVE PRODUCTS OF A TYPICAL VOLCANO IS WATER VAPOUR

VOLCANIC OUTGASSING OF THE EARLY (HADEAN) EARTH GRADUALLY LED TO THE ACCUMULATION OF STEAM IN THE PRIMITIVE ATMOSPHERE, AND AS EARTH COOLED, THIS CONDENSED TO FORM THE WORLD’S OCEANS AND ALLOW THE ONSET OF THE HYDROLOGICAL CYCLE

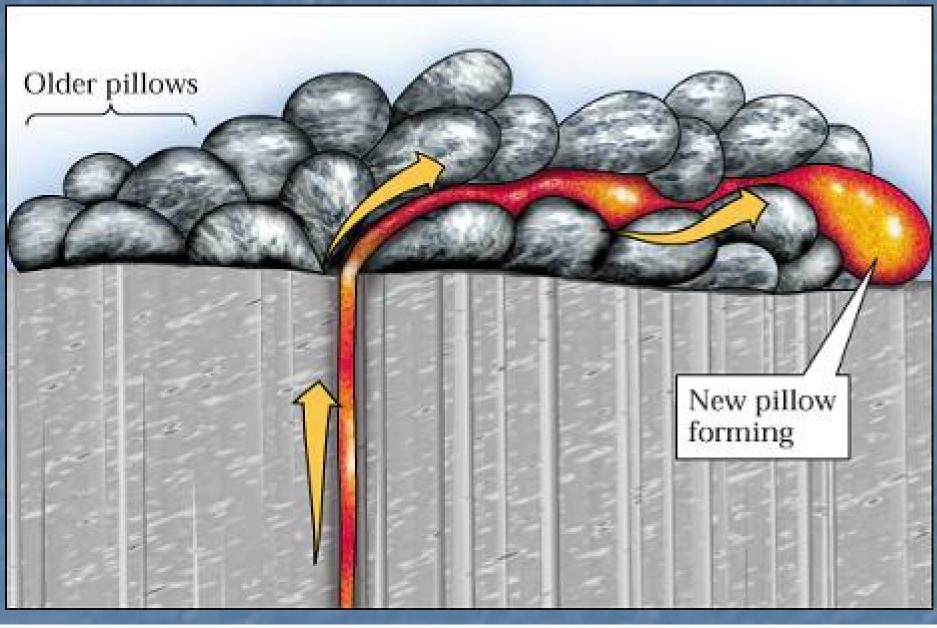
VOLCANIC DEGASSING CONTINUES TODAY AT SEA-FLOOR MID-OCEAN RIDGES

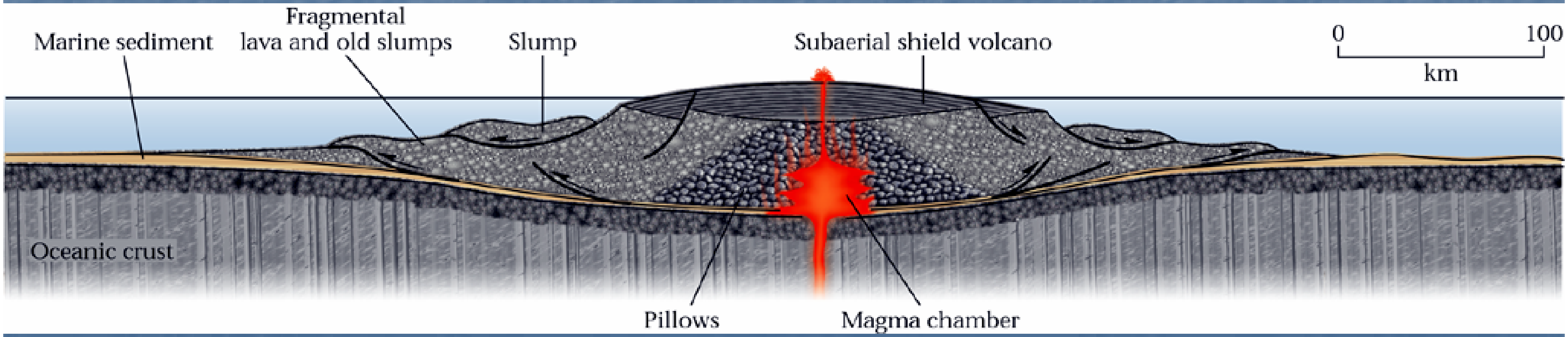
BASALT – the "bread of life" of the Earth

- **Basalt**, which is really just ocean floor, and which forms largely through seafloor volcanism, is the raw material from which continents (i.e. "land") are made, through a complex set of processes.
- The combination of basalt, water and pressure (through plate movements), forms the rock amphibolite – if this is partially melted, it forms tonalite, which then intrudes the amphibolite to form banded gneisses, which are the dominant rock types of continental crust. Melting of these banded gneisses will provide granites.
- As an added extra, basalt is essentially the primary source of gold.


Flowing Basaltic Lava, Kilauea, Hawaii
A tongue of fluid lava breaks through
the crust of cooling lava flow

Piles of pillow basalt lying upon oceanic crust. When subaerially exposed, shield volcano forms. Most mid-oceanic ridges don't develop enough basalt to be exposed subaerially



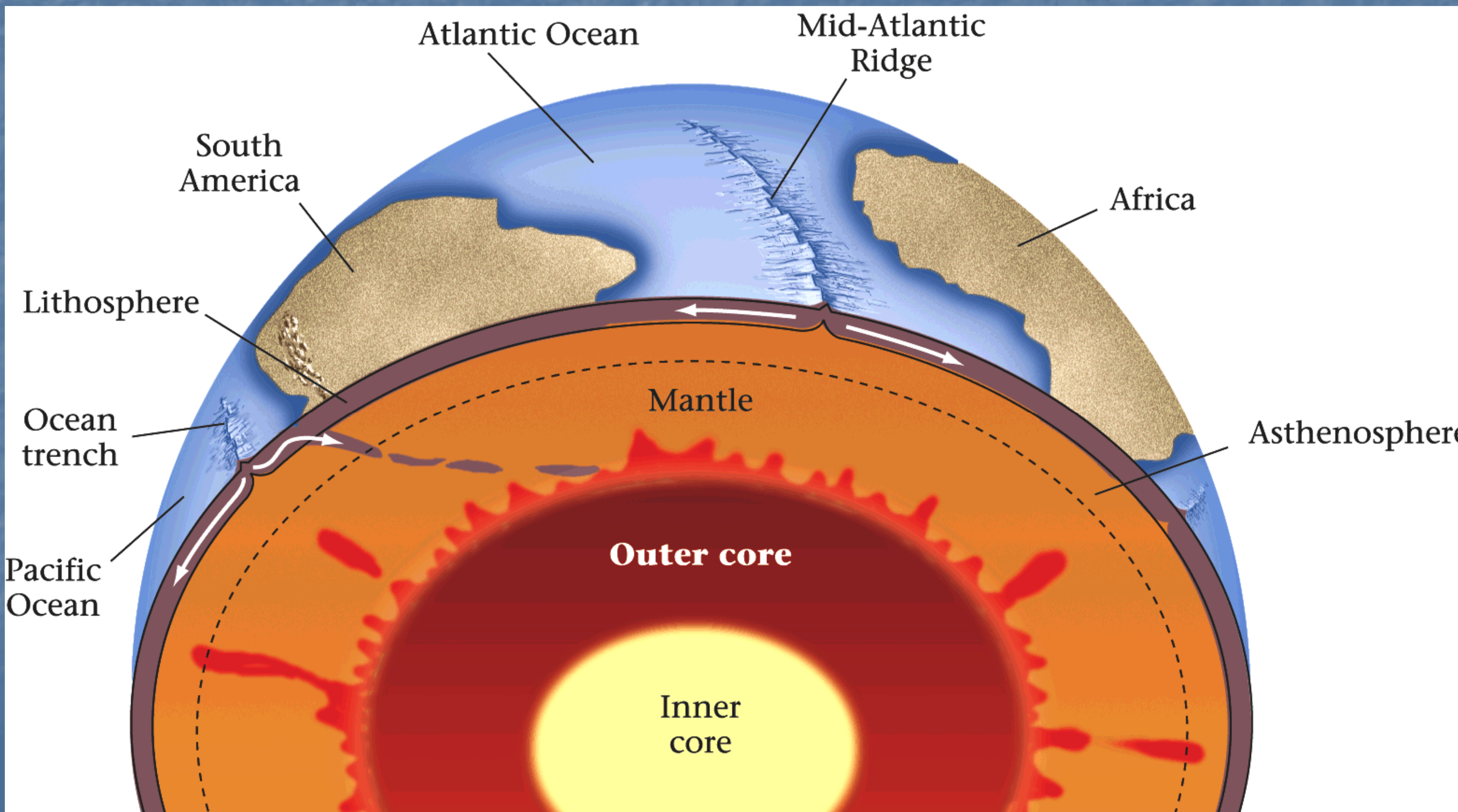


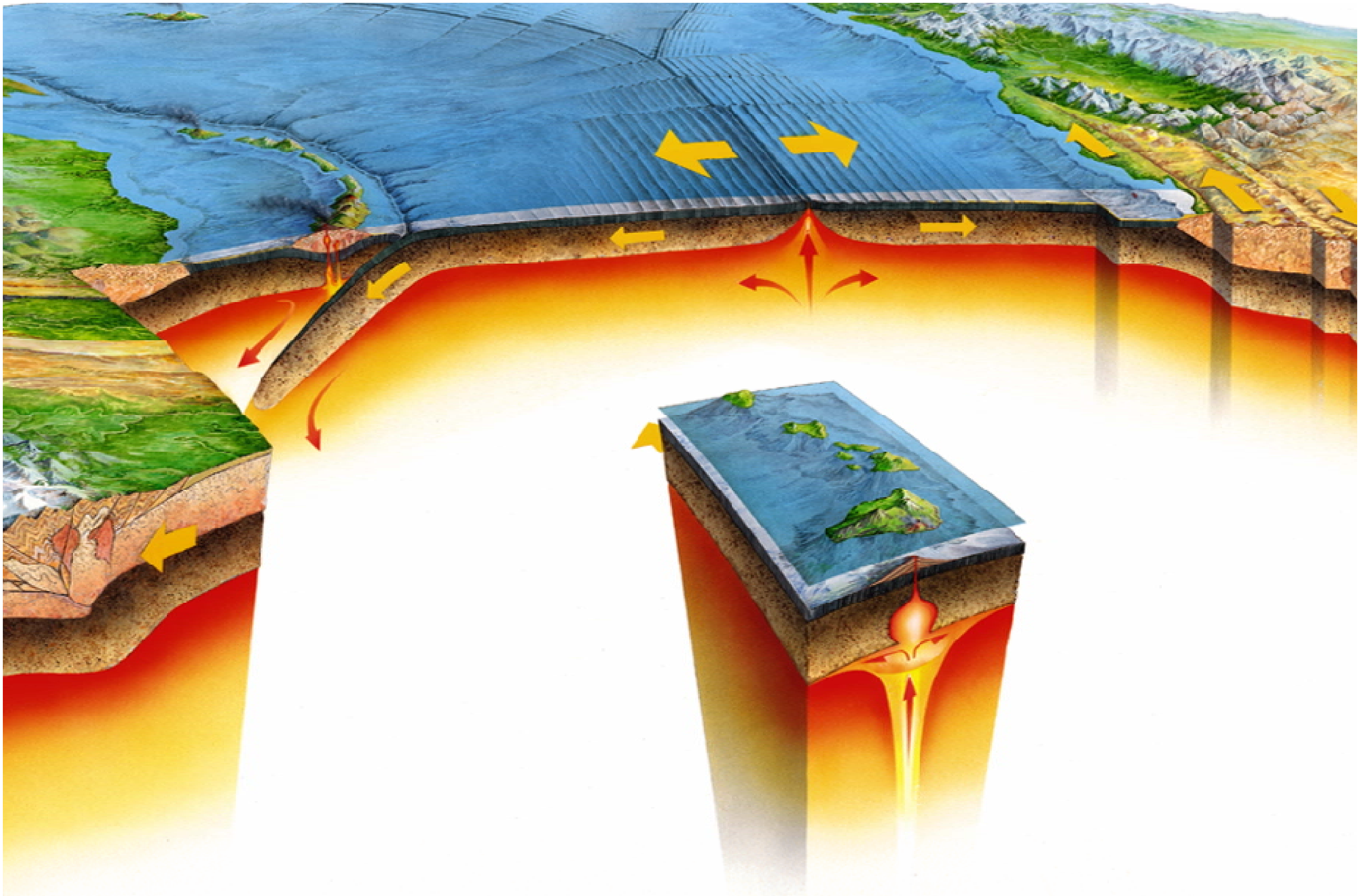
THE "EARTH SYSTEM"

The large-scale controls on the living Earth comprise a combination of plate tectonics and mantle plumes. The plates are relatively rigid oceanic or continental crustal plates that move, grow and are partially to completely destroyed, across the surface of Earth. Plumes are enormous masses of very hot (ca. 1500-1700 degrees C) that arise from the core-mantle boundary and ascend to beneath the Earth's crust. There they may flatten out and later lead to flood basalts (like the Drakensberg) erupting on the continental or oceanic plate surfaces, or they may occur locally as "hot spots" (e.g. Hawaiian volcanic island cones).

The removal of carbon (mostly in the form of limestones, and through weathered continental material) through plate tectonism from the atmospheric-hydrospheric system when ocean crust is subducted back into the mantle, is responsible for oxygen accumulating in Earth's atmosphere.

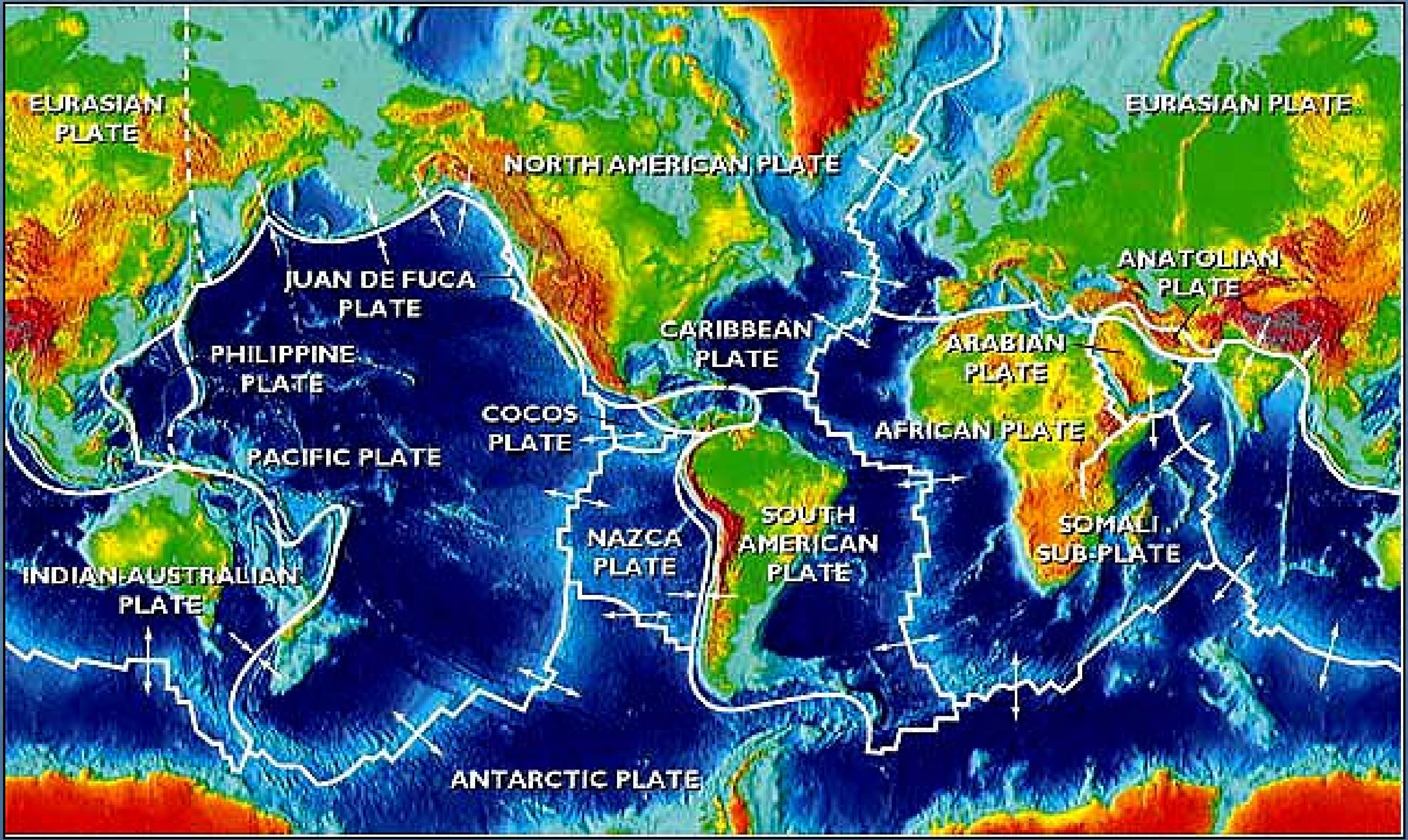
THE ROLE OF PLATE TECTONICS

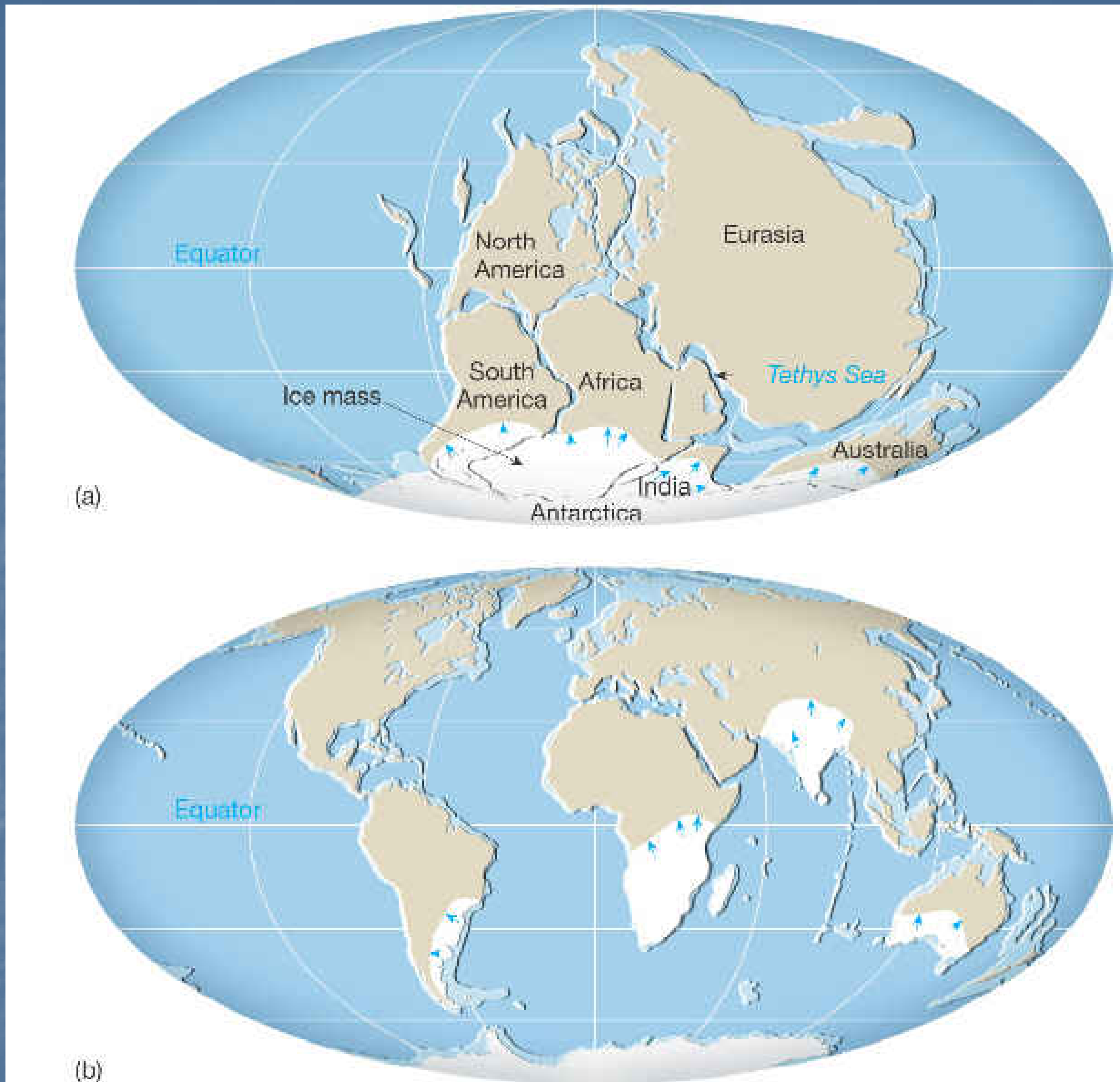




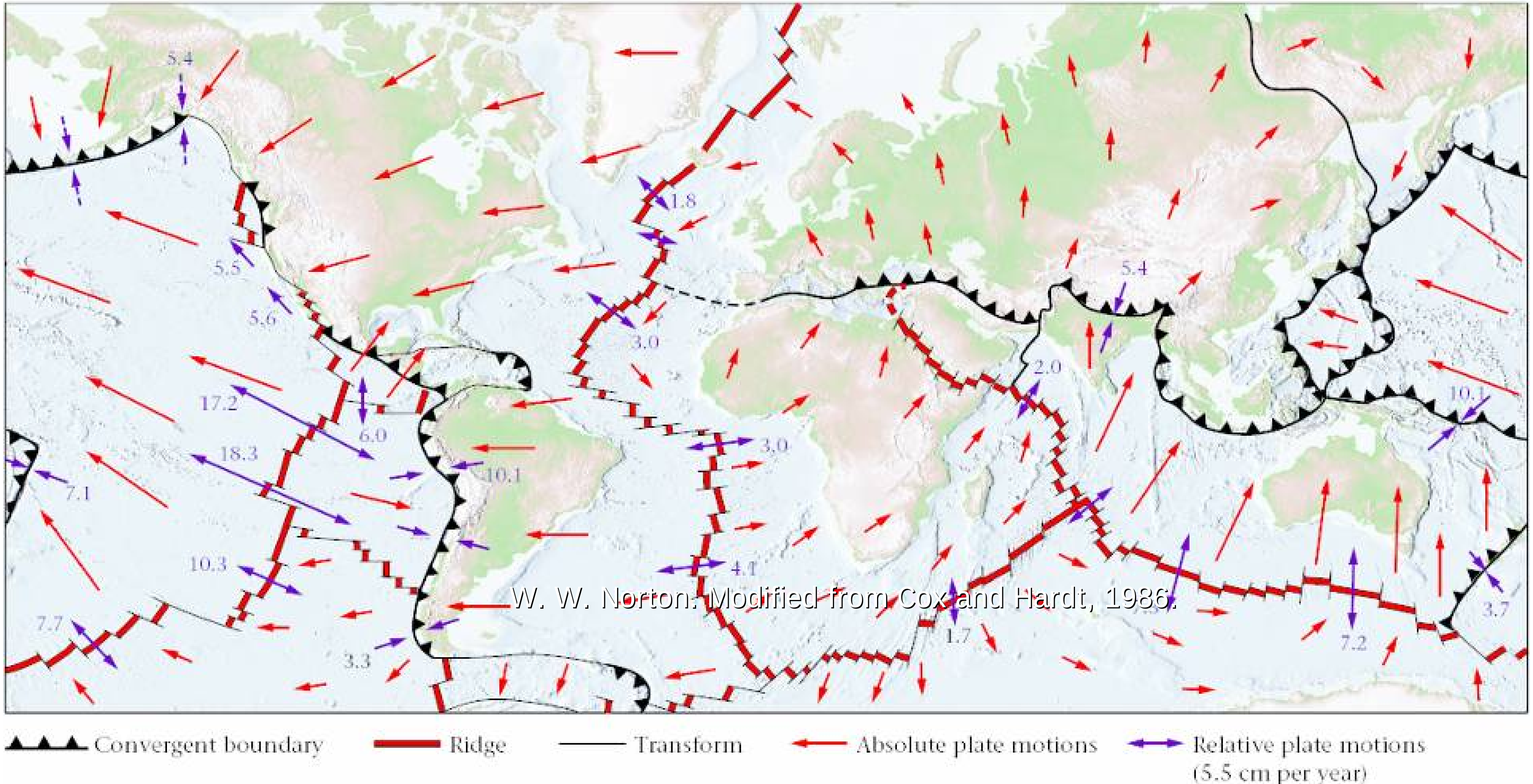
Flattened view of Earth's land and undersea topography

Plate tectonics: the lithosphere is not a continuous shell, but broken into about a dozen large rigid plates, that are in motion over the Earth's surface.The mantle beneath is hot and ductile and flows under the influence of convection currents.



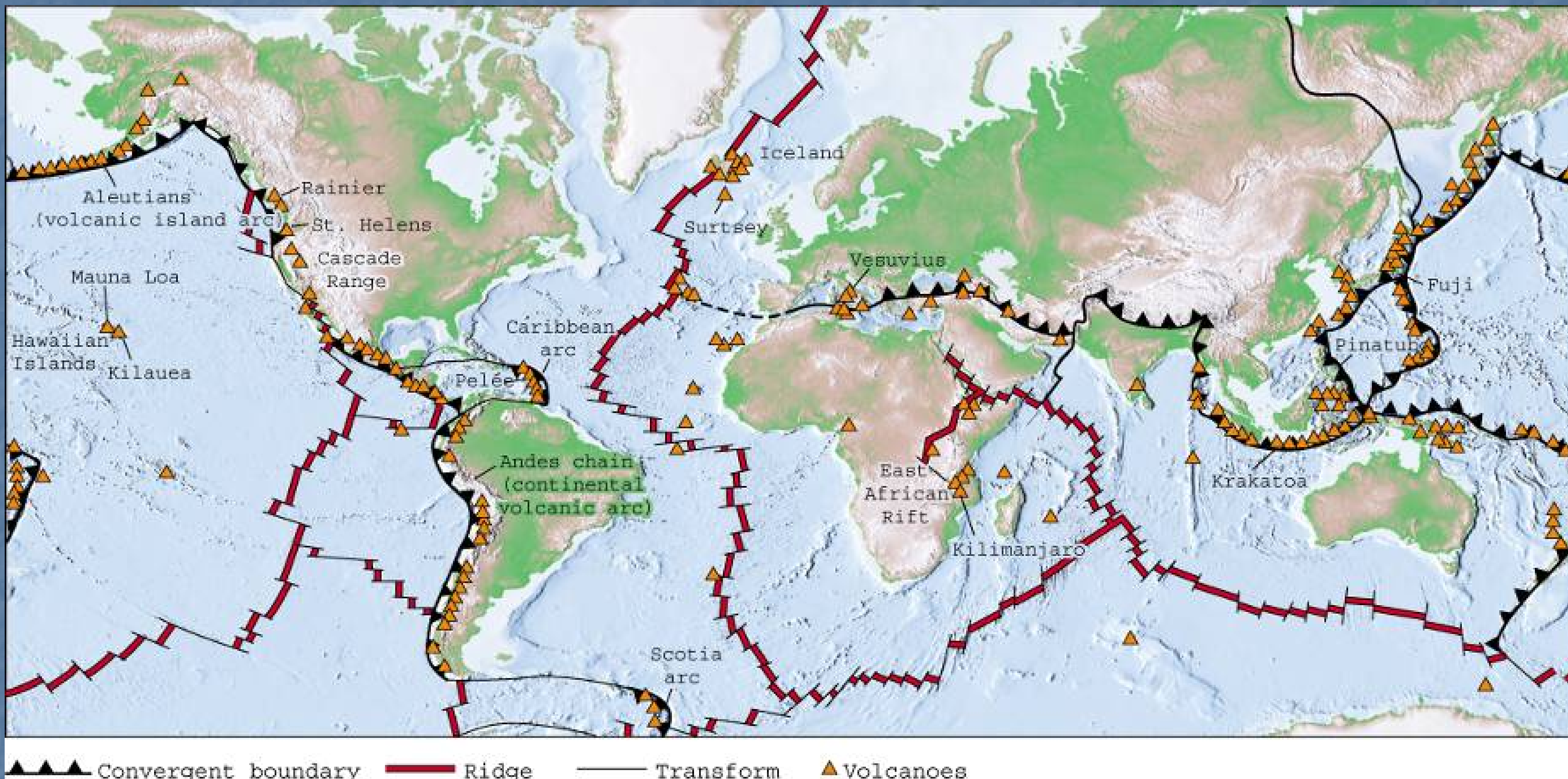


Movement of plates: Late Carboniferous – Early Permian time period (ca. 270 Ma) at top and modern world below, showing areas bearing Glacial deposits of that earlier age

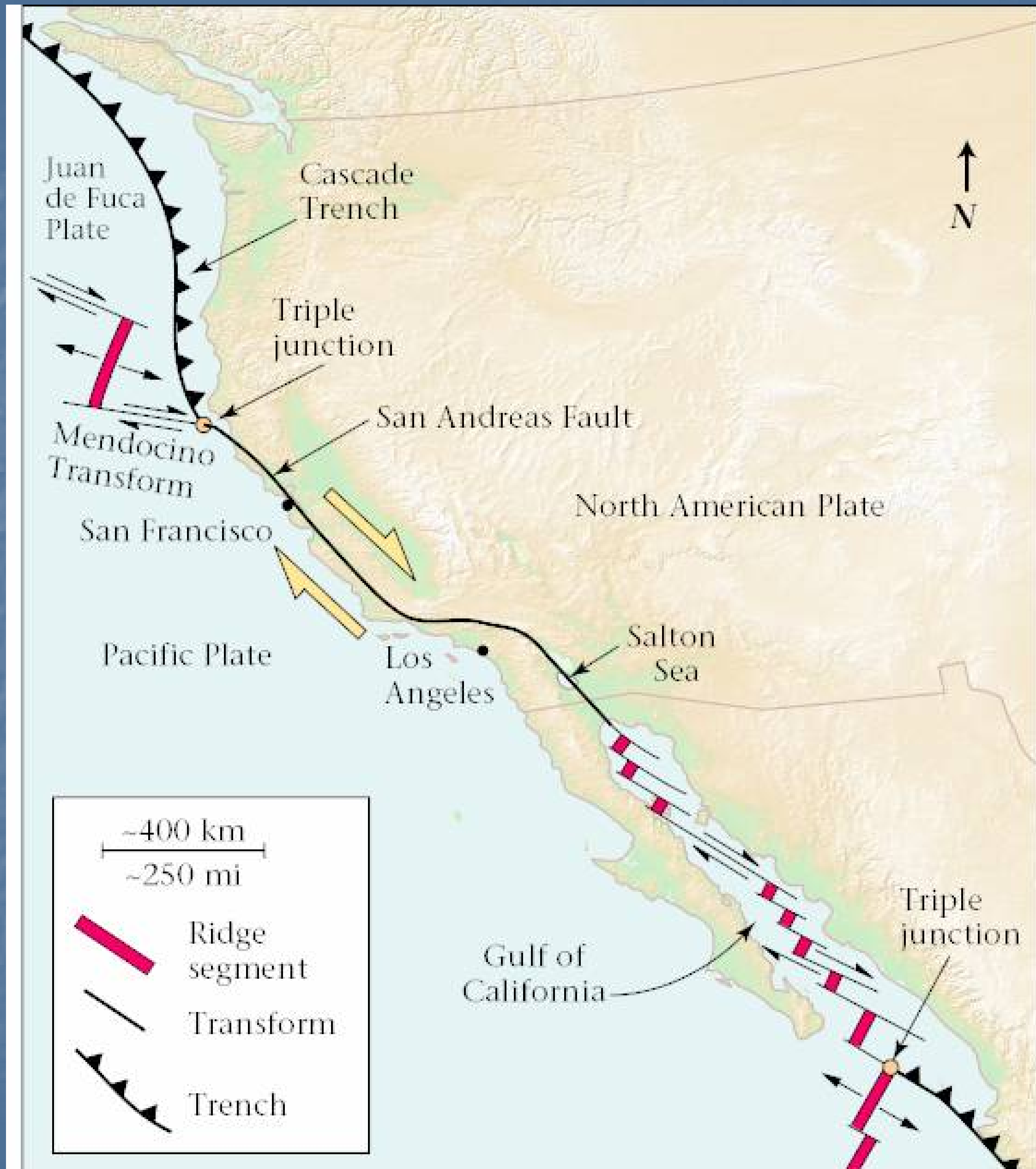


W. W. Norton: Modified from Cox and Hardt, 1986.

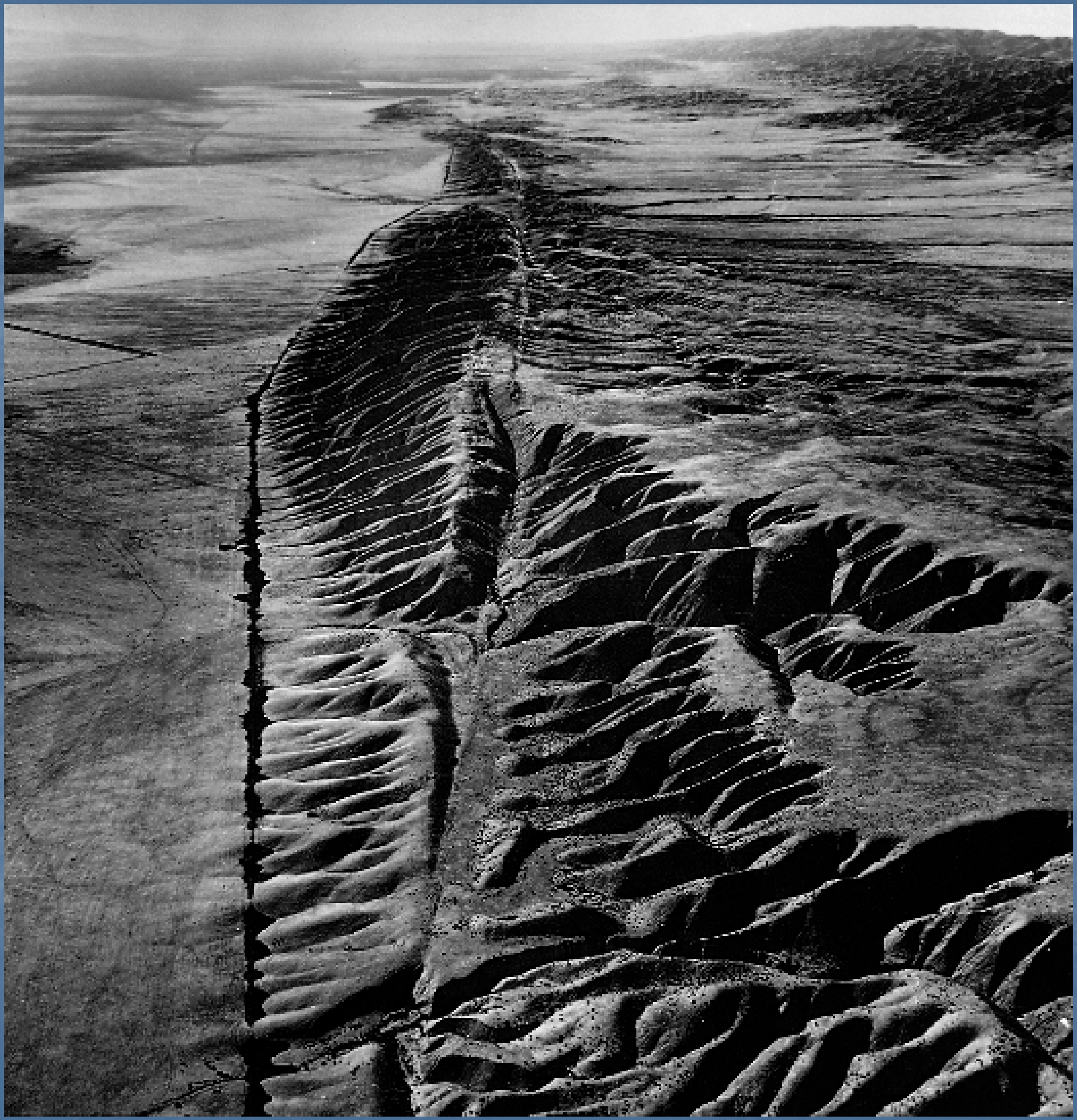
Measured movements and rates of modern plates on Earth



Same major tectonic plates as previous slide, with active volcanoes and volcanic chains added

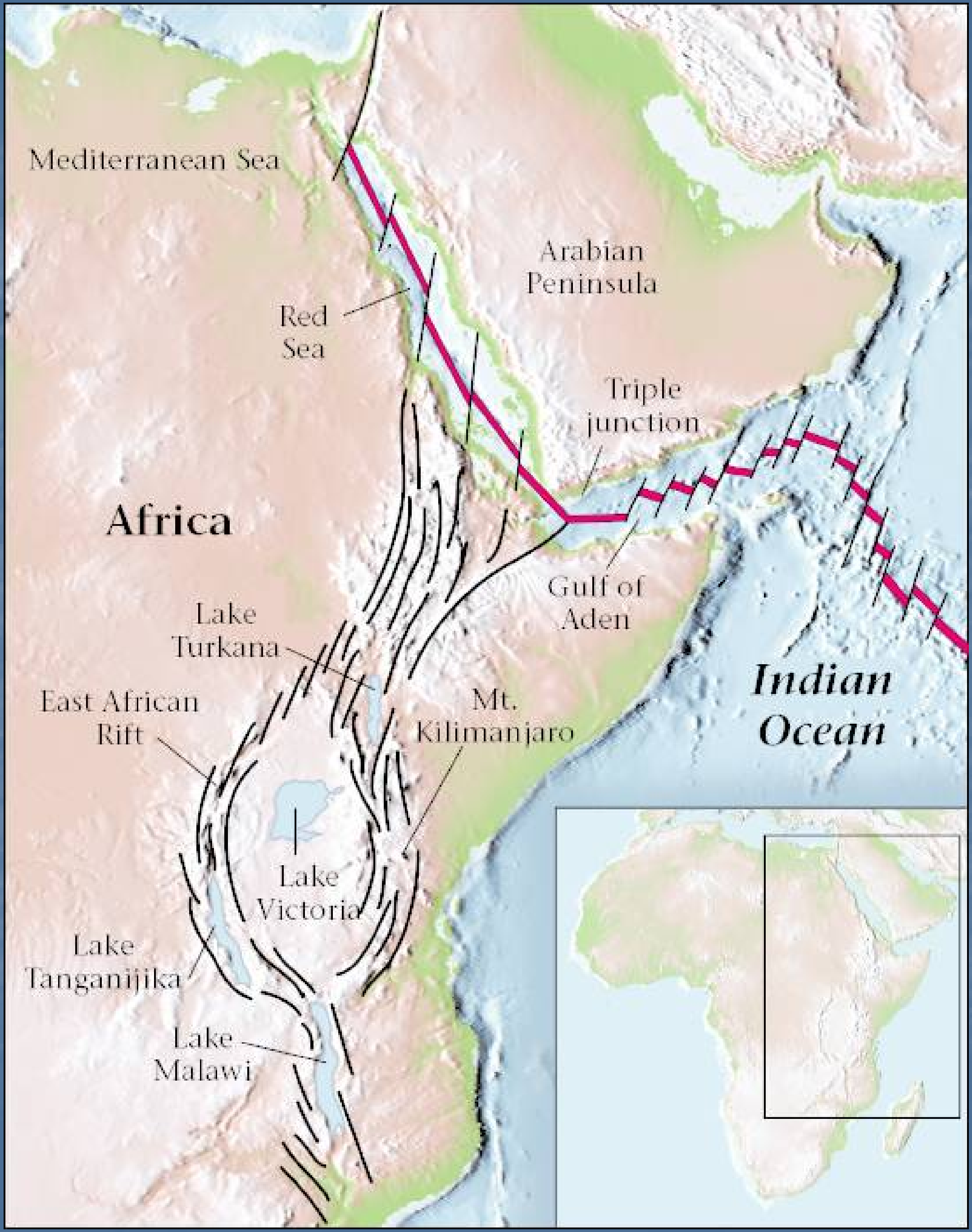


San Andreas fault system in California active strike-slip movement on this is about 5.5 cm per year



San Andreas fault system from the air

The San Andreas fault is the border between two tectonic plates—the North American Plate and Pacific Plate. Los Angeles is located on the Pacific Plate, and San Francisco is on the North American Plate. In a few million years, the two geographic areas will be right next to each other because the western side of the fault (the Pacific Plate) is moving northward with respect to the rest of the state. The fault is moving at about 2 centimetres per year.



East African Rift System and the Horn of Africa triple junction – active movement of plates in Africa

THE EARLY EARTH

The combination of plumes and allied mantle-derived (cf. igneous) basaltic products made possible the creation of the plates (and arising therefrom, plate tectonics) – plate tectonics, once established combined with plumes to provide the first-order control on Earth dynamics – plumes often break continental amalgamations (supercontinents) apart and help to drive the plate tectonic (Wilson) cycle on Earth.

Once we have moving plates (cratons), the formation of significant sedimentary basins begins, a major facet of our geological surrounds at UP

PART THREE: THE HISTORY OF OUR SURROUNDINGS AT UP AND ITS HINTERLAND – CRATONS, PLUMES AND ***BASINS***

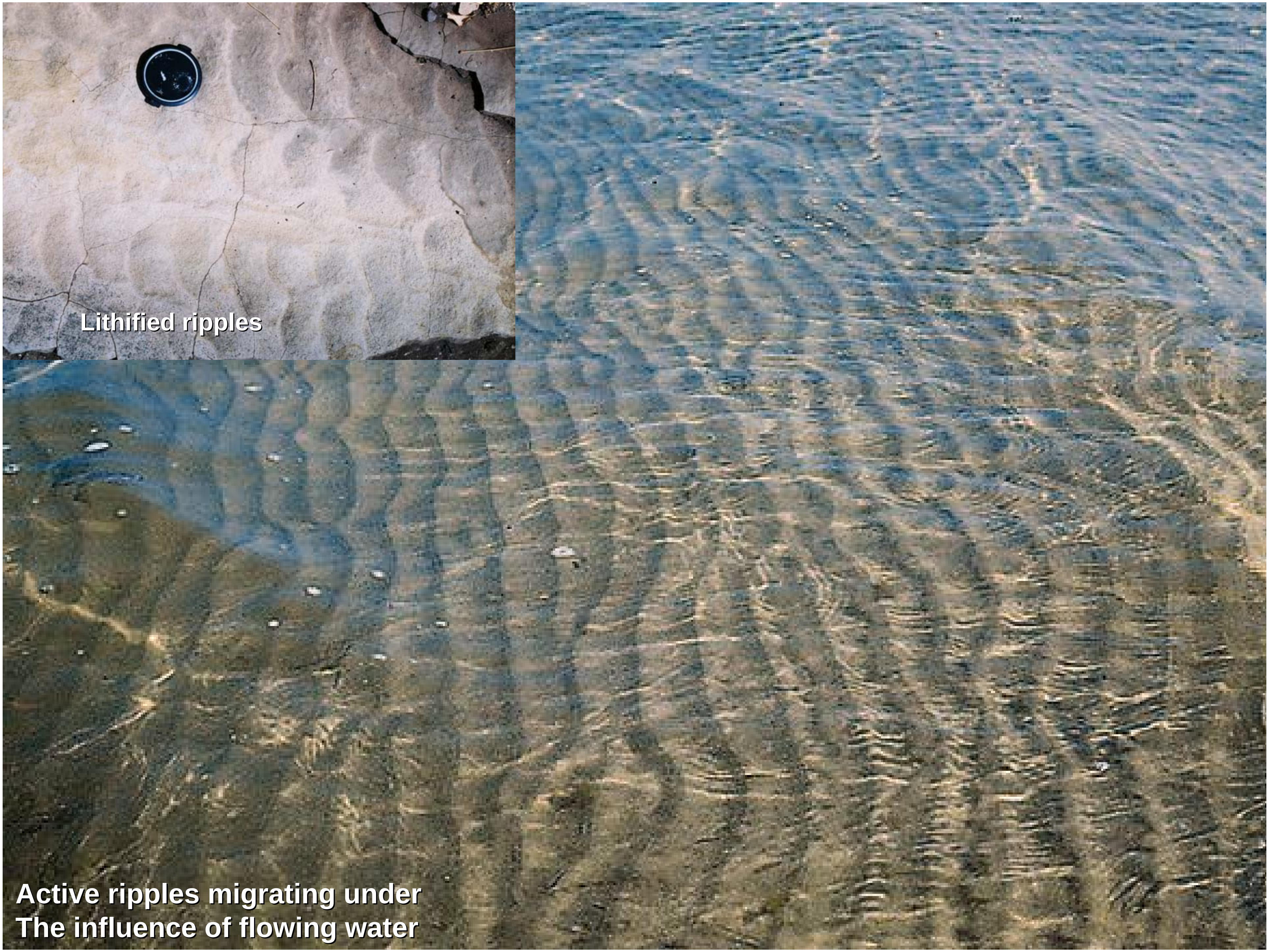
Chemical weathering starts with the mixture of (rain)water with atmospheric gases, particularly carbon dioxide:

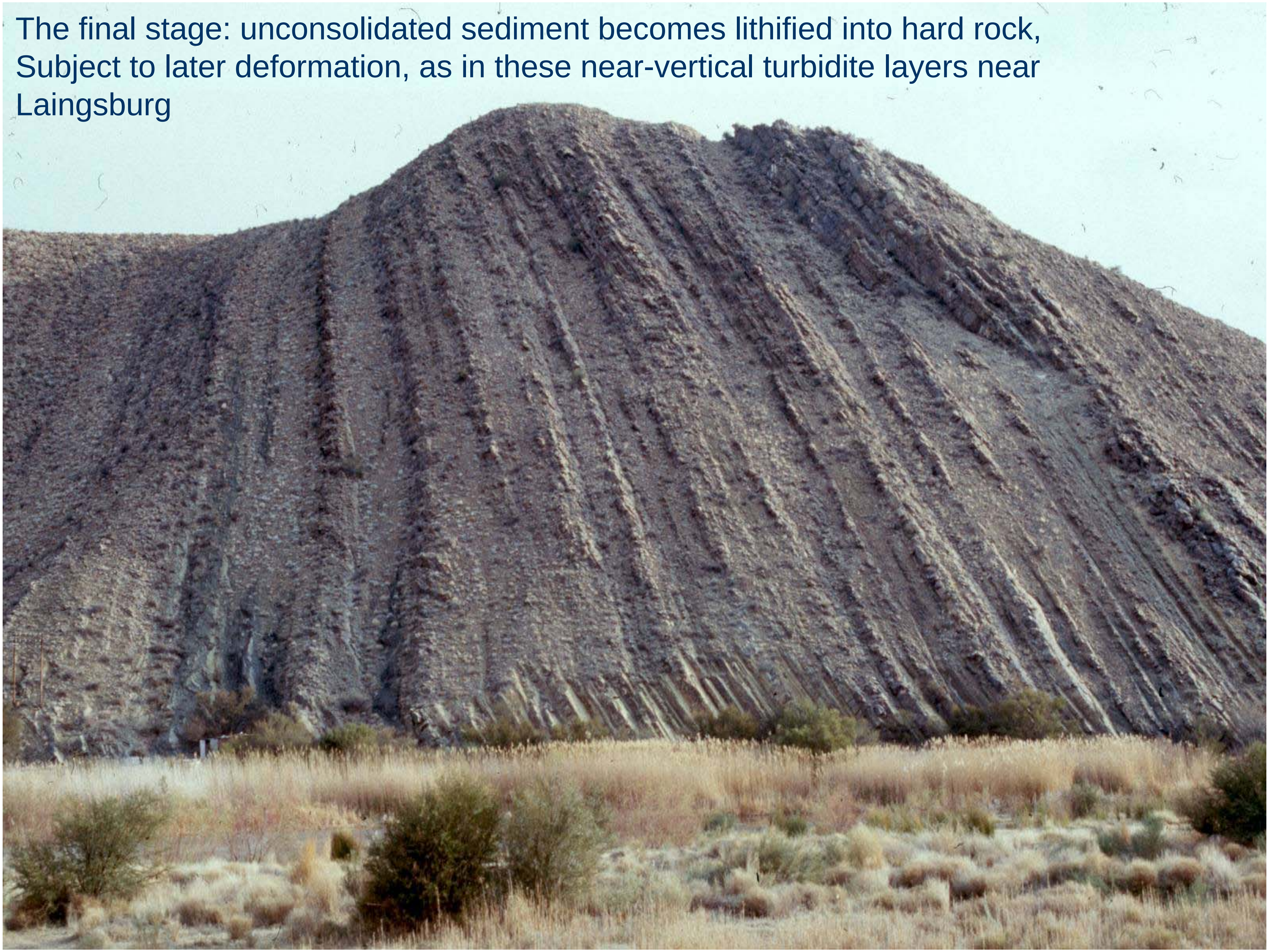
$$H_2O + CO_2 = H_2CO_3$$

to produce carbonic acid, which begins weathering of rocks, and the production of loose sediment particles

As weathering proceeds, sediment (or detritus) collects adjacent to the weathered residual rocks and is subject to transport and removal

The weathered detritus is then transported (by running water, ice, wind and gravity) and laid down elsewhere as sediment, which lithifies into sedimentary rocks


Lithified ripples
Active ripples migrating under
The influence of flowing water



The final stage: unconsolidated sediment becomes lithified into hard rock, Subject to later deformation, as in these near-vertical turbidite layers near Laingsburg

Oxygen and plate tectonics

Once primitive life developed, the process of photosynthesis, combining carbon dioxide and water to produce organic carbon, led to oxygen being added to the early Earth's atmosphere.

As decay of the organic carbon uses just as much oxygen as its formation produces, it is only the removal of organic carbon from the cycle that leads to oxygen accumulating in the atmosphere over time.

Plate tectonics removes such carbon, in subduction zones at the sea floor.

<u>In essence thus, the natural systems operating within and upon the Earth all act together and have mutual feedback relationships.</u>

Water plays a crucial role throughout. Water makes plate tectonics possible, helped form life, helps control atmospheric composition, and even made possible the formation of continental crust; all this quite apart from its well-known role in the weathering-erosion-sedimentation cycle.

BASIN ANALYSIS OF PRECAMBRIAN DEPOSITORIES

SOME BASIC PRINCIPLES:

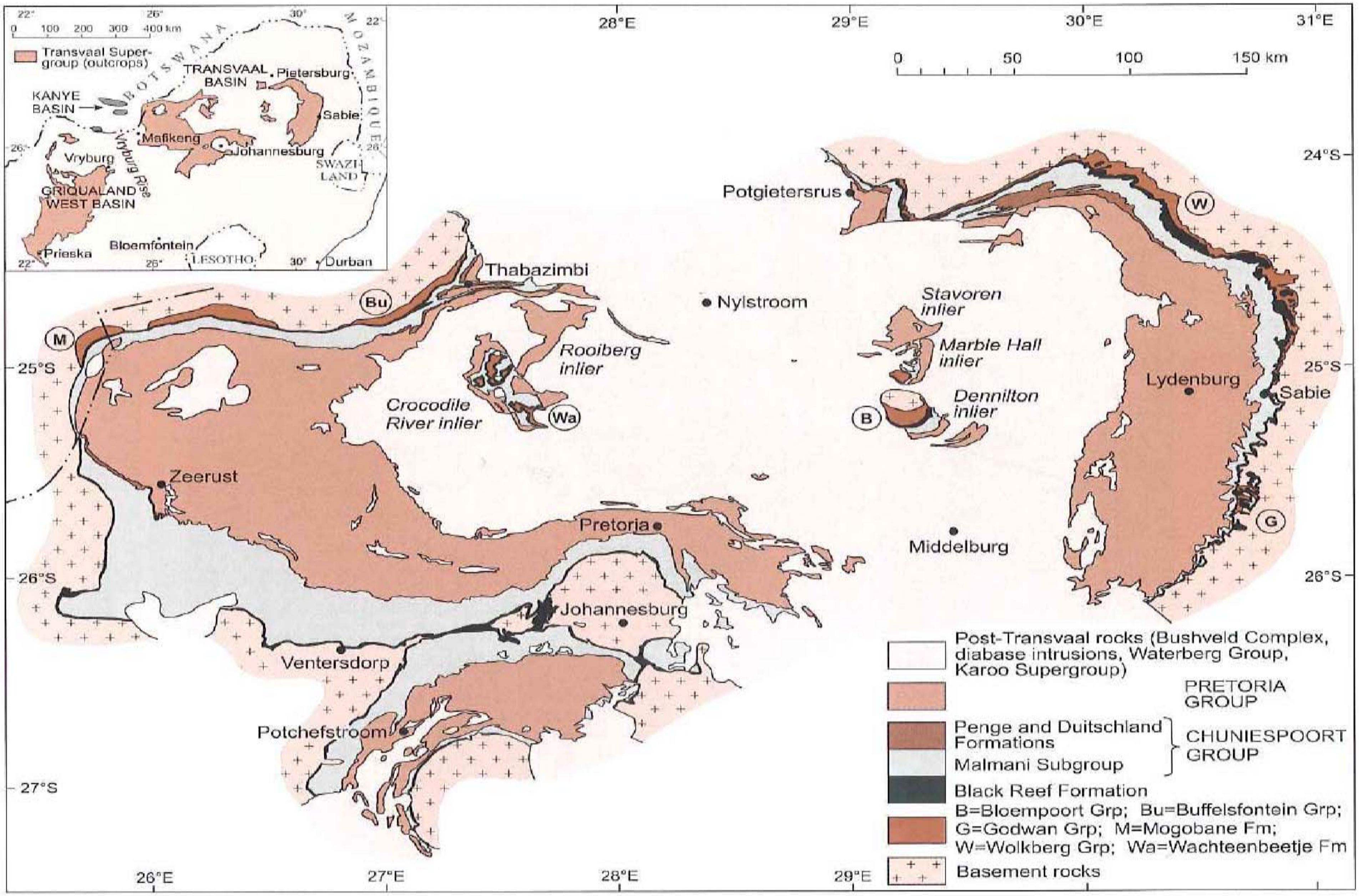
(1) qualified uniformitarianism – same processes and products, but rates and intensities varied greatly over (Precambrian) time.

(2) Concepts of primary and preservational basins. Often the same preserved basin-fill comprises a mixture of these.

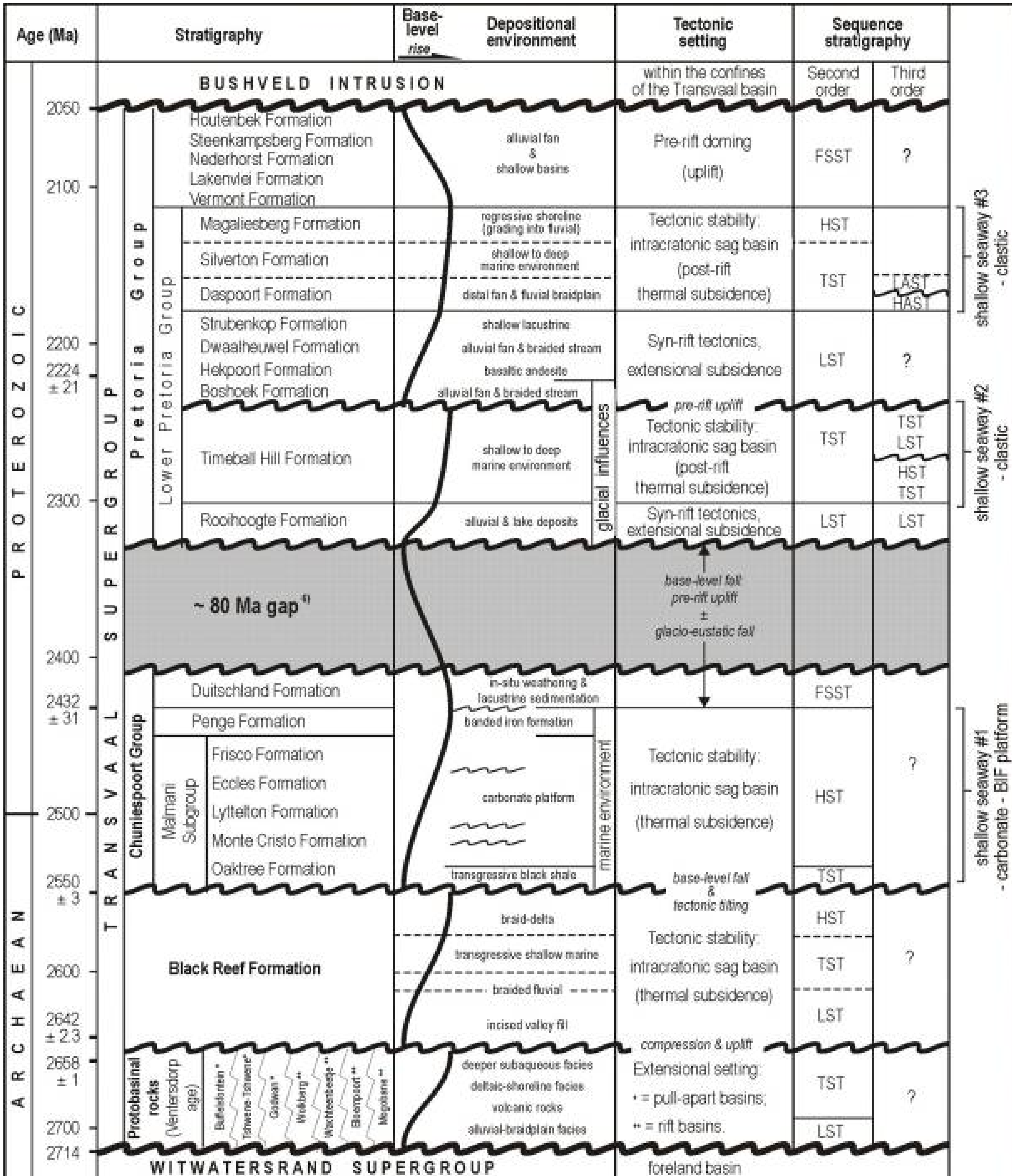
(3) Prime controls on basin evolution are the relationship between sediment supply and accommodation ("starved and stuffed" basins).

THE TRANSVAAL SUPERGROUP: FLOOR ROCKS TO THE BUSHVELD COMPLEX

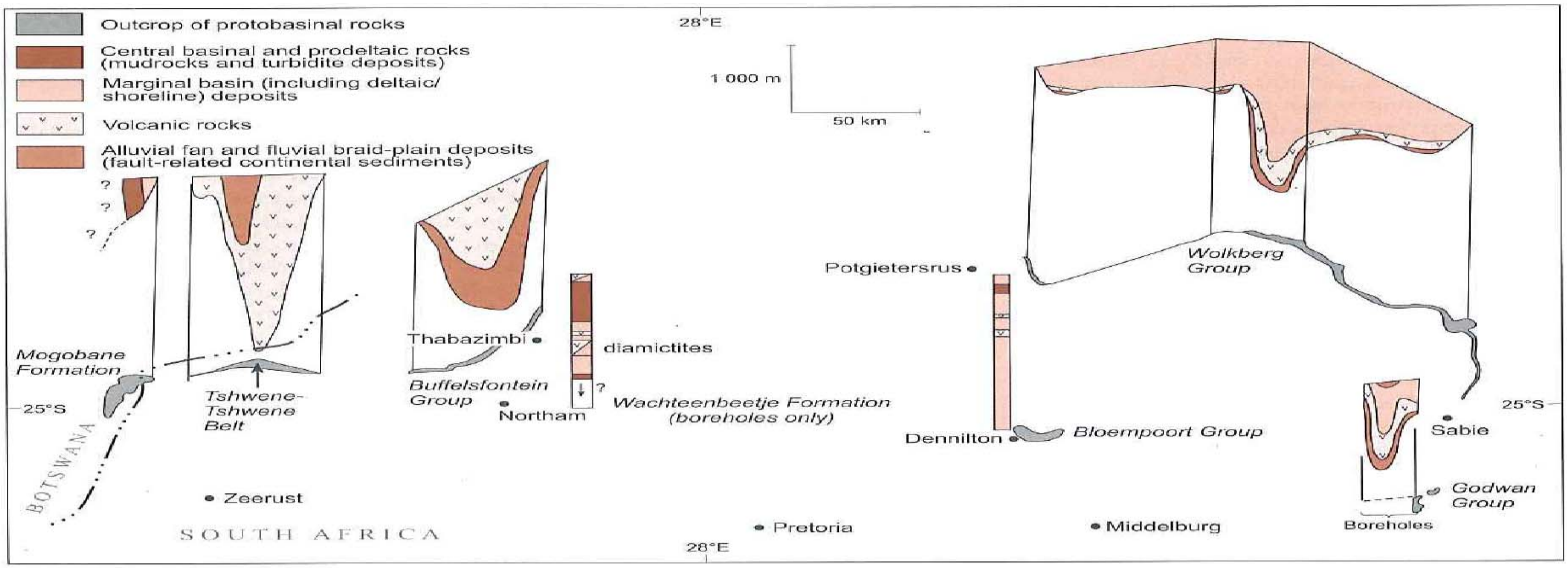
The location of mantle plumes (e.g., the Bushveld Complex) within the brittle upper crust is related to crustal thinning, and they thus commonly intrude beneath thick, upper crustal basin-fills – this is the essence of the relationship between the Bushveld Complex and the Transvaal basin



Map of Transvaal Basin – Bushveld Complex intruded within its central portions



Stratigraphy, genesis and sequence stratigraphy of the c. 2.68 – 2.05 Ga Transvaal Supergroup



Transvaal basin "protobasinal" rocks - geometry indicates rifting environment, most likely related to a mantle plume at about 2.68 Ga. Rifts filled mainly by immature sediments and lavas, with later thermal subsidence as plume subsides leading to more mature and deeper basinal deposits in the centre of this set of rifted basins.

Plumes at work and affecting plates

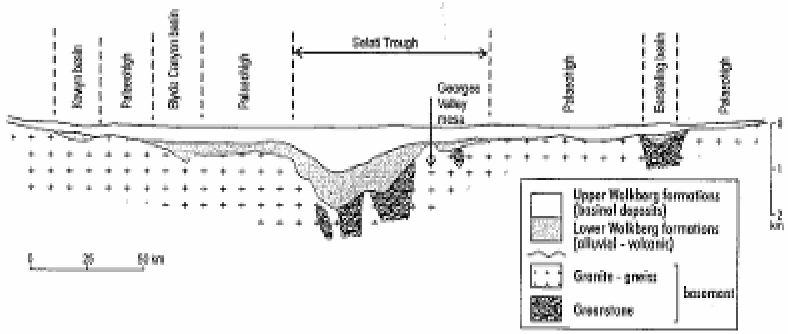


Fig. 4. Profile through the preserved Wolkberg basin, illustrating relationship of the Wolkberg thickness patterns and sub-basins separated by basement highs to basement lithologies. Note sub-basins filled mainly by immature alluvial deposits and volcanic rocks (lower Wolkberg formations) overlying basement occurrences of greenstones, with succeeding basinal deposits being much more widespread, transgressing onto basement granite-gneiss highs, and with a more tabular geometry (upper Wolkberg formations). Modified after Button (1973).

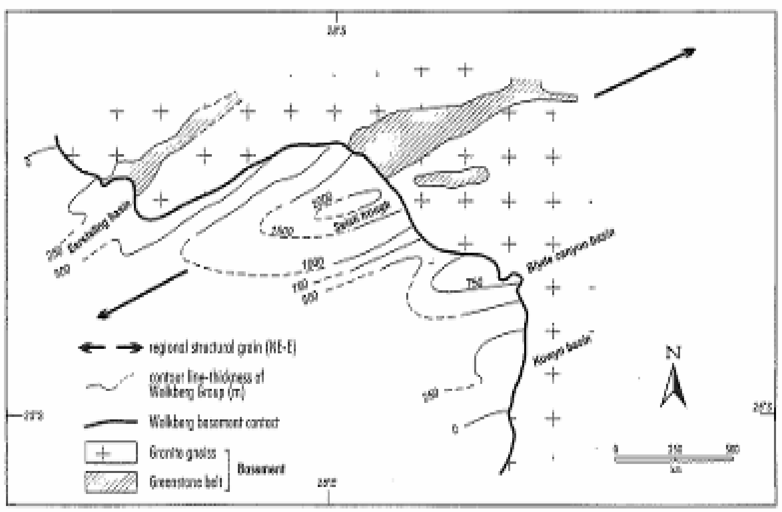
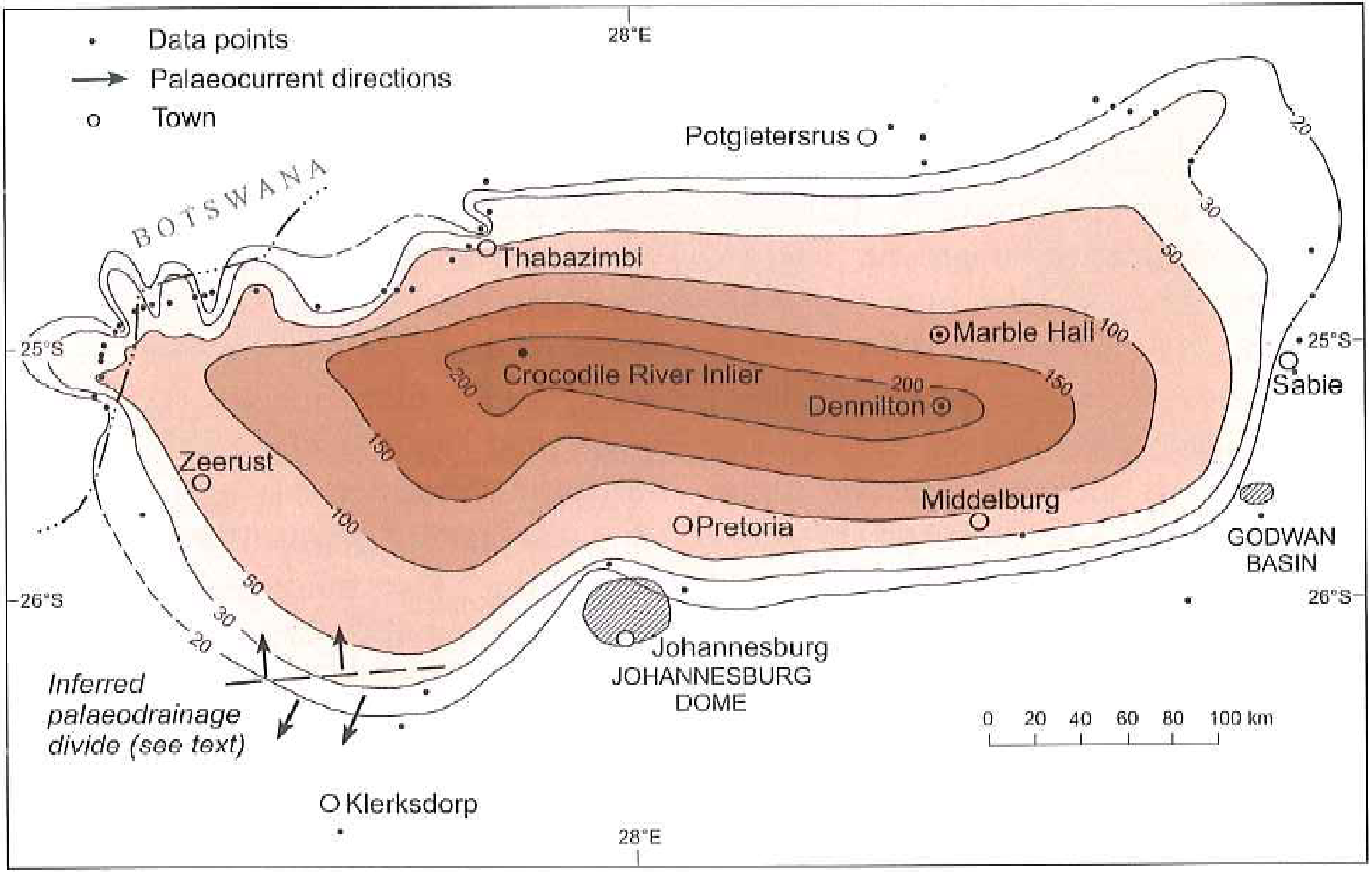
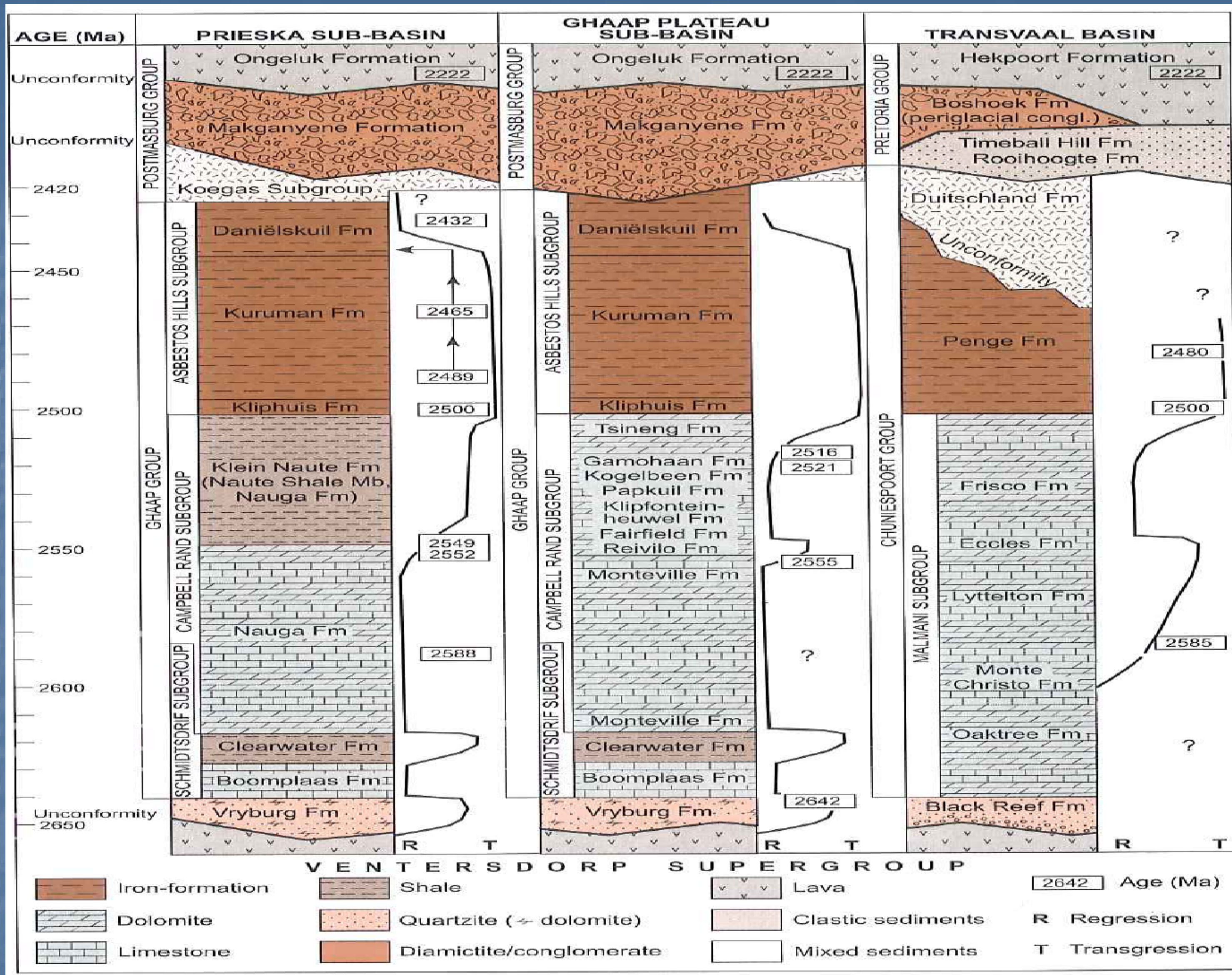


Fig. 5. Sketch isopach map for the Wolkberg Group (compare with Fig. 4), illustrating Wolkberg sub-basins commonly coincident with greenstone belts developed in the Archaean basement. Note also the overall regional structural grain, oriented approximately ENE–WSW. Modified after Button (1973).

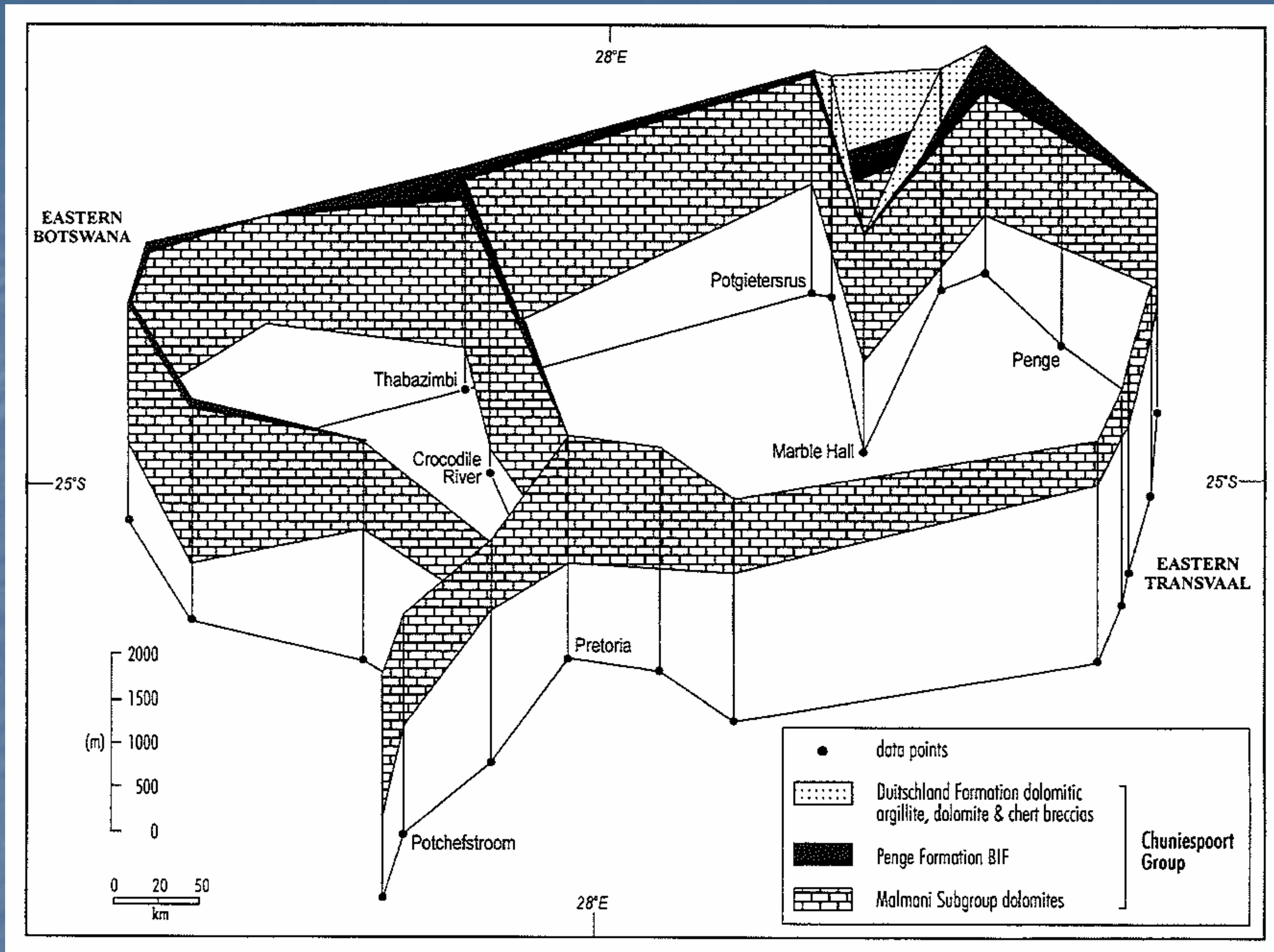
Protobasinal rifts lie above pre-existing crustal sutures marked by greenstone belts (= ancient basaltic island arc complexes related to crustal evolution)



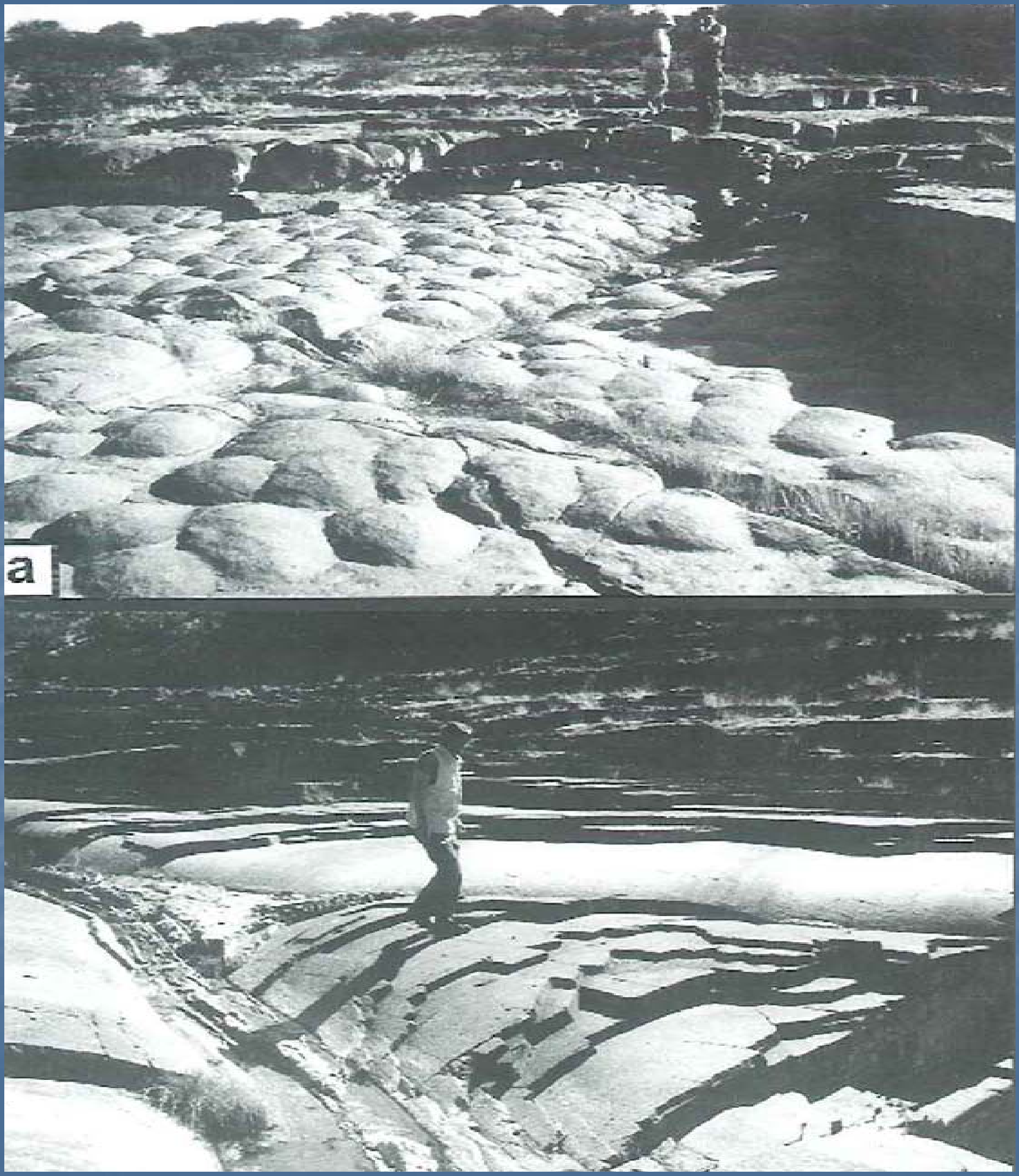
Black Reef Formation: thin (30-60 m average) sheet sandstones, laid down by rivers in basin deepening towards centre



Malmani carbonate – banded iron formation chemical sedimentary System, laid down in vast clear (clastic sediment-free) epeiric sea Covering large part of South Africa: sea advanced from SW to NE and retreated off the craton 5 times.



Sheet of chemical sediments (carbonates and BIF) spread across Transvaal basin by advancing and retreating epeiric sea



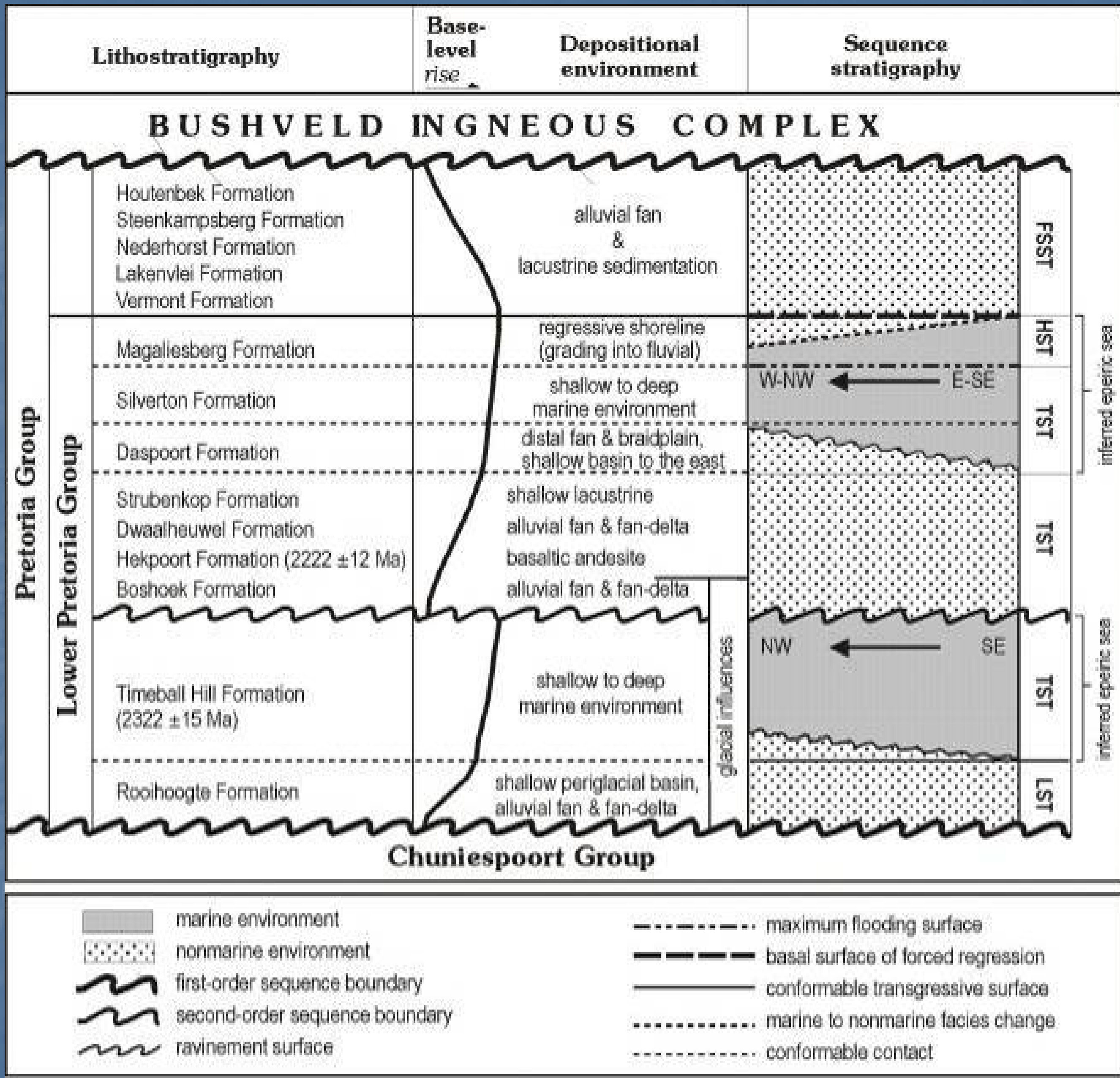
Malmani Dolomite:

Dome-shaped stromatolites (top) and elongated huge stromato-lites (bottom) influence by strong tidal currents.

Reflect growth of cyano-bacteria in shallow, clear, warm Transvaal sea, which covered a major part of the continental (craton) area at that time.

FORMATIONS		Inferred palaeoenvironments
Houtenbek	Mudrock (tuffaceous in places), sandstone, limestone	Fan, fan-delta, delta, shallow lacustrine
Steenkampsberg	Sandstone	
Nederhorst	Sandstone (arkosic in places) Mudrock (tuffaceous in places)	
Lakenvalei	Sandstone	
Vermont	Mudrock (tuffaceous in places)	
Magaliesberg	Sandstone with mudrock lenses and interbeds	Regressive sandy shoreline, braid-delta, high-energy tidal flat
Silverton	carbonate rocks Lydenburg Shale Member (commonly tuffaceous) Machadodorp Volcanic Member (pyroclastic rocks, basalt) Boven Shale Member	Relatively deep water, transgressive epeiric sea; volcanic activity, mainly in the east
Daspoort	Sandstone, mudrock	Distal fan, fluvial braidplain, braid-delta; transgressive epeiric sea in the east
Strubenkop	Mudrock, subordinate sandstone	Transgressive lacustrine
Dwaalheuwel	Sandstone, conglomerate, subordinate mudrock	Alluvial fan, fan-delta
Hekpoort	Basaltic andesite, pyroclastic rocks	Volcanic
Boshoek	Sandstone, conglomerate, diamictite	Alluvial fan, slump deposits
Timeball Hill	Upper mudrock unit Diamictite/conglomerate/arkose lens Klapperkop Quartzite Member Lower mudrock unit Bushy Bend Lava Member	Relatively deep lacustrine (with suspension sedimentation and turbidity currents), distal fluvio-deltaic, basal volcanism in south and southwest
Rooihoogte	Polo Ground Sandstone Member Mudrock, subordinate carbonate rocks Bevets Conglomerate/Breccia Member	Karst-fill, alluvial fan, lacustrine
Chuniespoort Group	Iron-formation, dolomite	

Stratigraphic succession of the Pretoria Group and changes across the basin: essentially comprises thick epeiric sea units (= Timeball Hill and Daspoort-Silverton-Magaliesberg Fms.) alternating with fluvial deposits and some lavas (Hekpoort and Machadodorp Lavas)



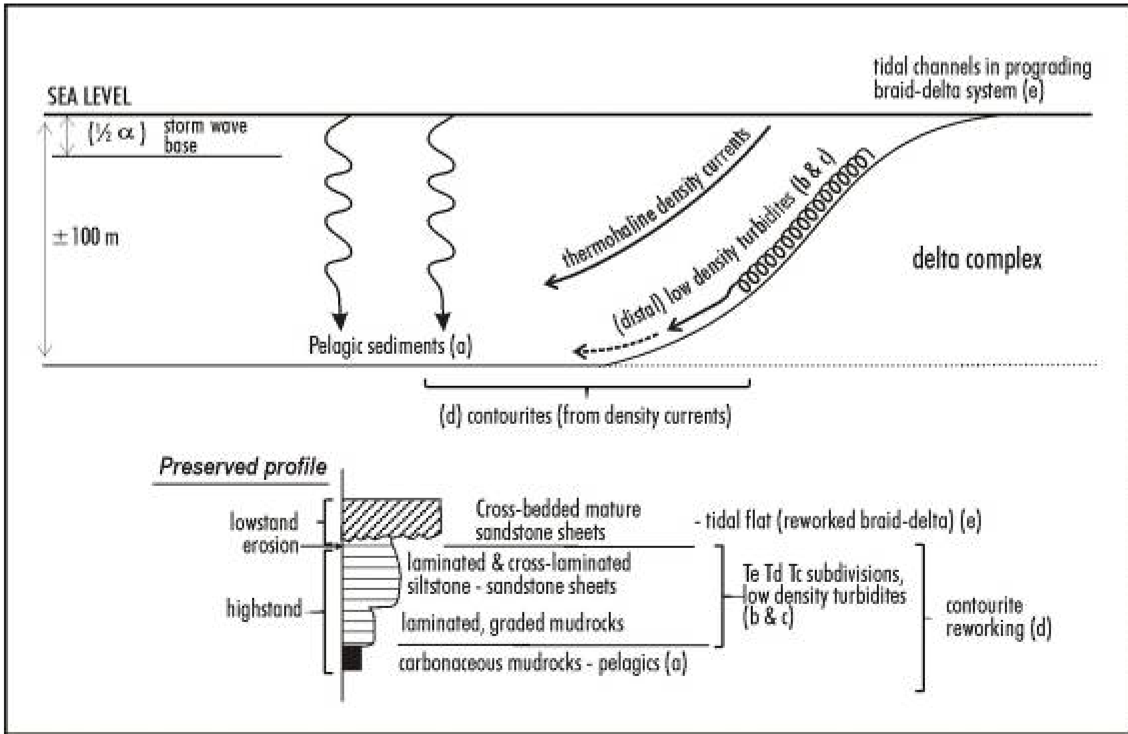
Sequence stratigraphy of the Pretoria Group: two major marine transgressions (shaded in grey), separated by essentially fluvial intervals (dots)

(TST = transgressive systems tract
HST = highstand systems tract
LST = lowstand systems tract
FSST = falling stage systems tract)

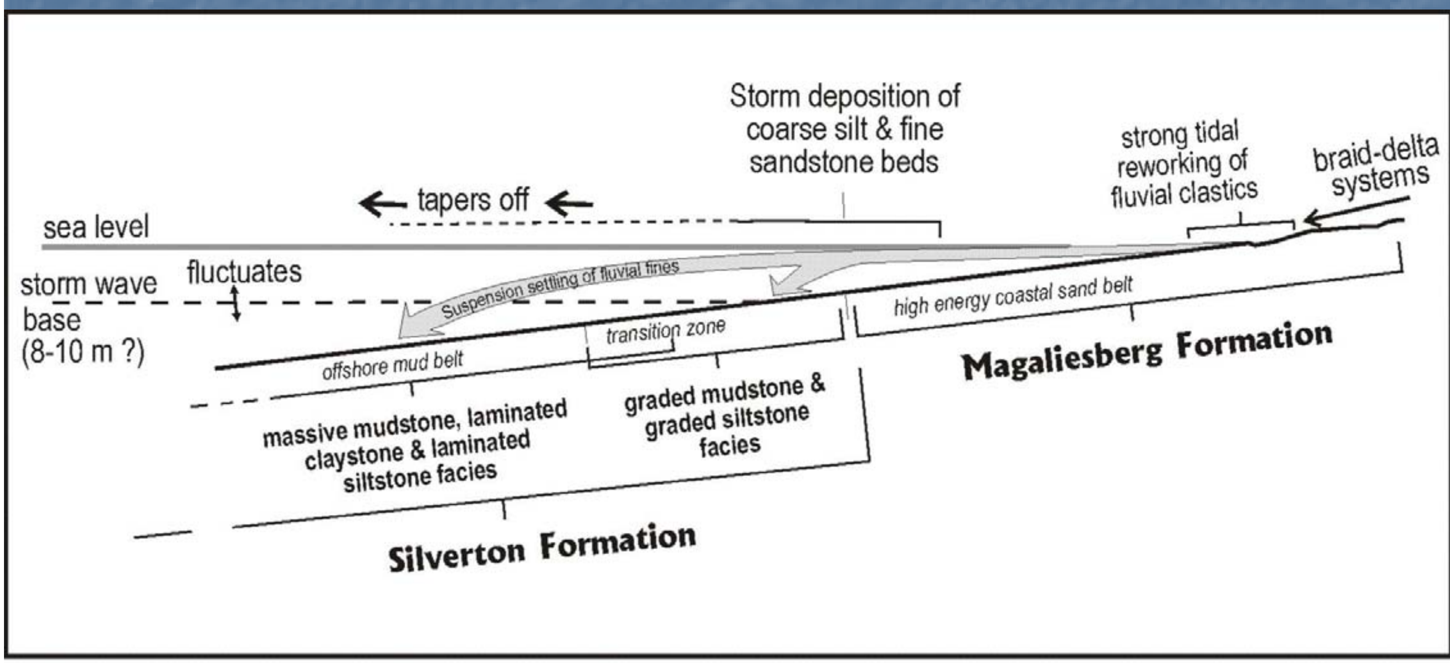
GENERAL CHARACTER OF PRETORIA GROUP BASIN

- Dominated by two alternating and co-existing sedimentation systems:
- (1) high gradient, high mud-carrying braided river systems (dominate also in the Waterberg Group);
- (2) variable depth and energy-levels within vast epeiric seas developed on planed off cratons;
- (3) both systems tend to have episodic sedimentation.

Large braided river systems, lacking mud between channels but with muddy sediment within channels



Epeiric sea model for Timeball Hill Formation: deep, rift-related Basin with turbidites, contour Currents etc.



Epeiric sea model for Magaliesberg Formation: shallow sea comparable to modern shelves

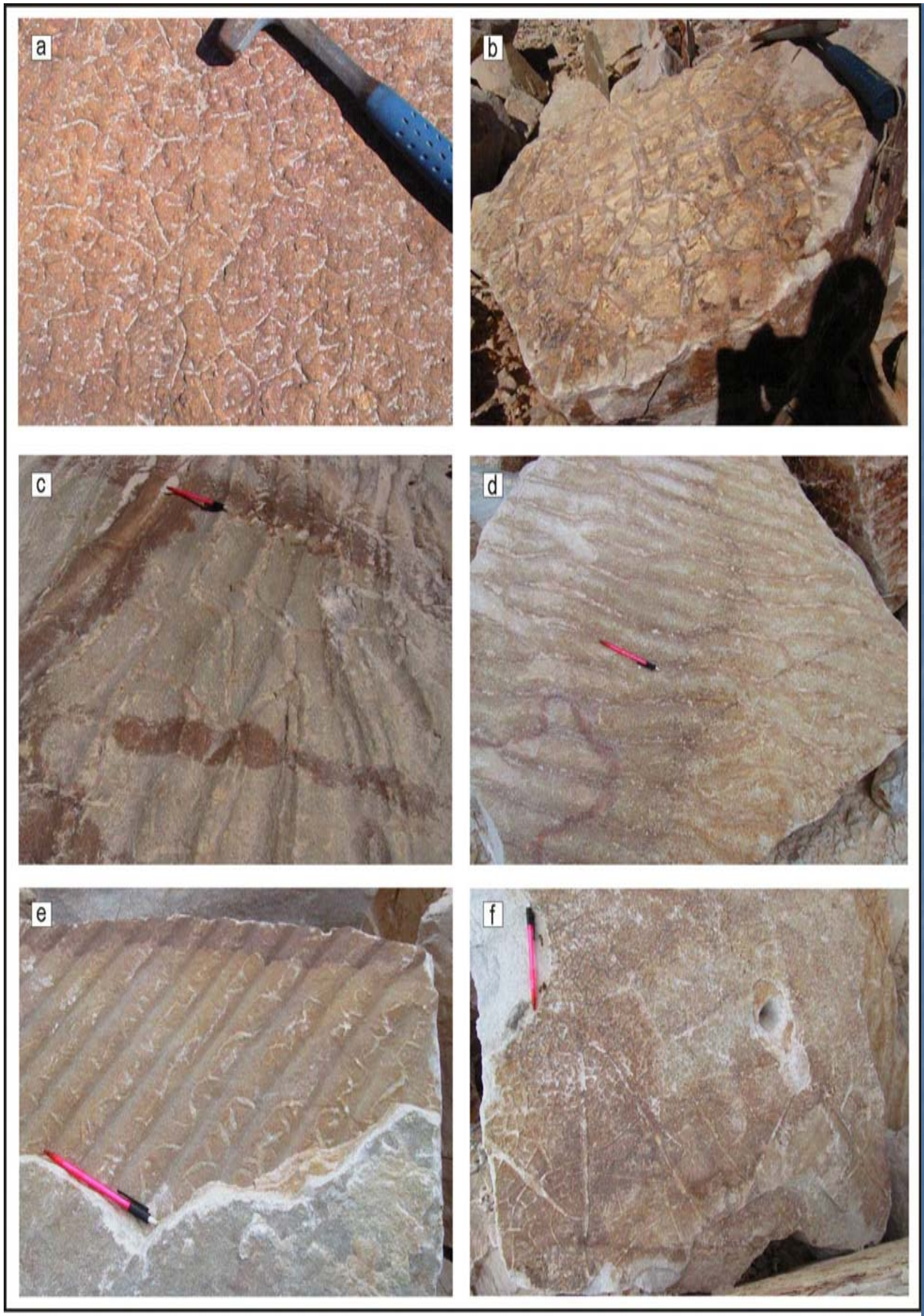
Magaliesberg Fm. within the Transvaal Supergroup basin

Vast epeiric seas: low wave energy, dominated by tides

Epeiric sea coastlines of the Pretoria Group contain a wealth of microbial mat- related sedimentary structures.

Some examples from the Magaliesberg sea coastline will be shown next.

Today these mats and their products are much less pervasive due to the grazing activities of metazoans.



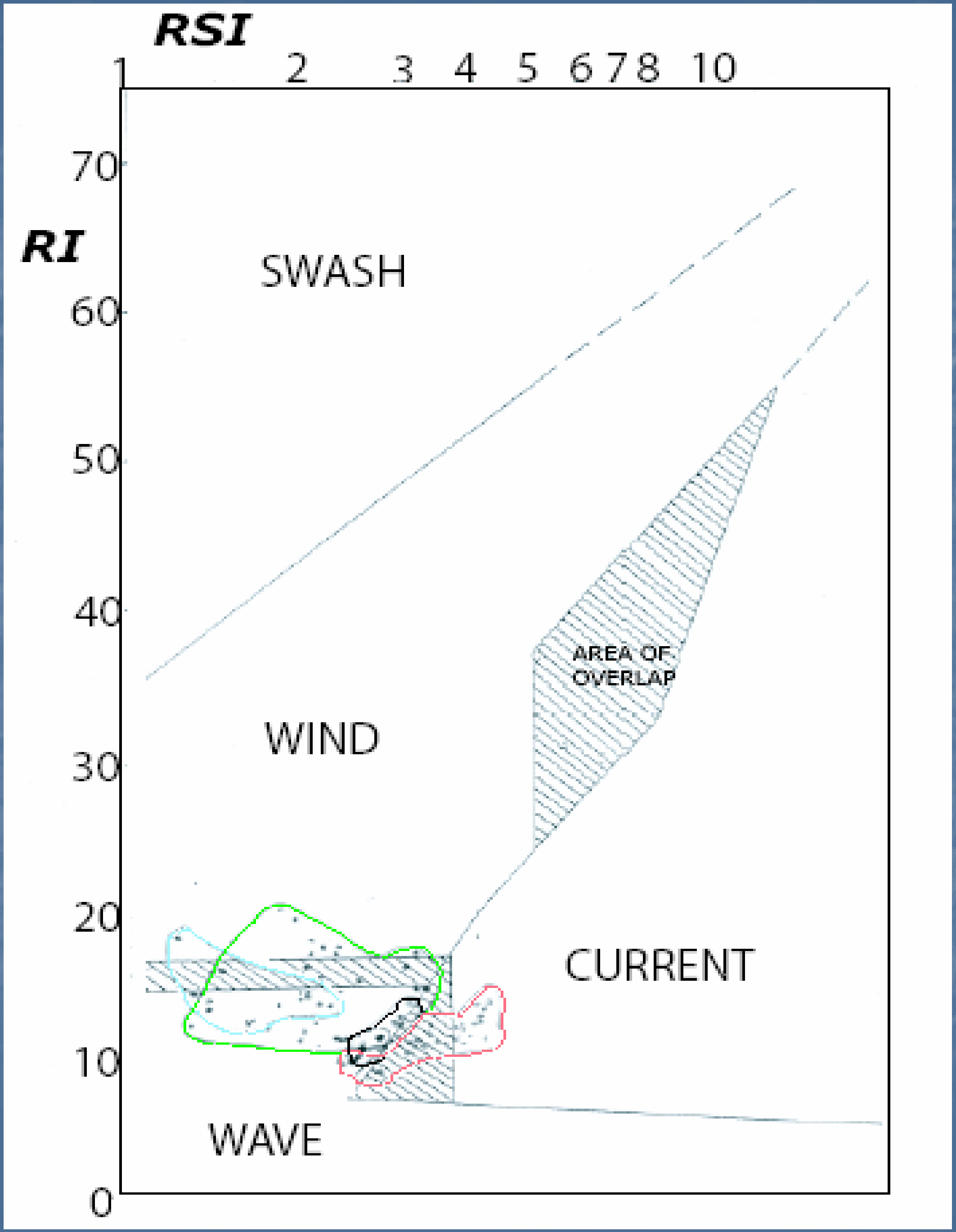
MAT-RELATED FEATURES IN MAGALIESBERG SANDSTONES

(a) Two orders of slightly flattened petee ridges;
(b) Three orders of petee ridges;
(c) Ripple crest sand cracks;
(d) Ripple trough sand cracks;
(e) *Manchuriophycus* (pseudofossil) which are sinuous sand cracks formed in ripple troughs – seen here as sole marks on lower surface of succeeding bed;
(f) Wrinkle structures superimposed on two orders of petee ridges.

Petee ridges in sandstone – often mistaken for “mudcracks”

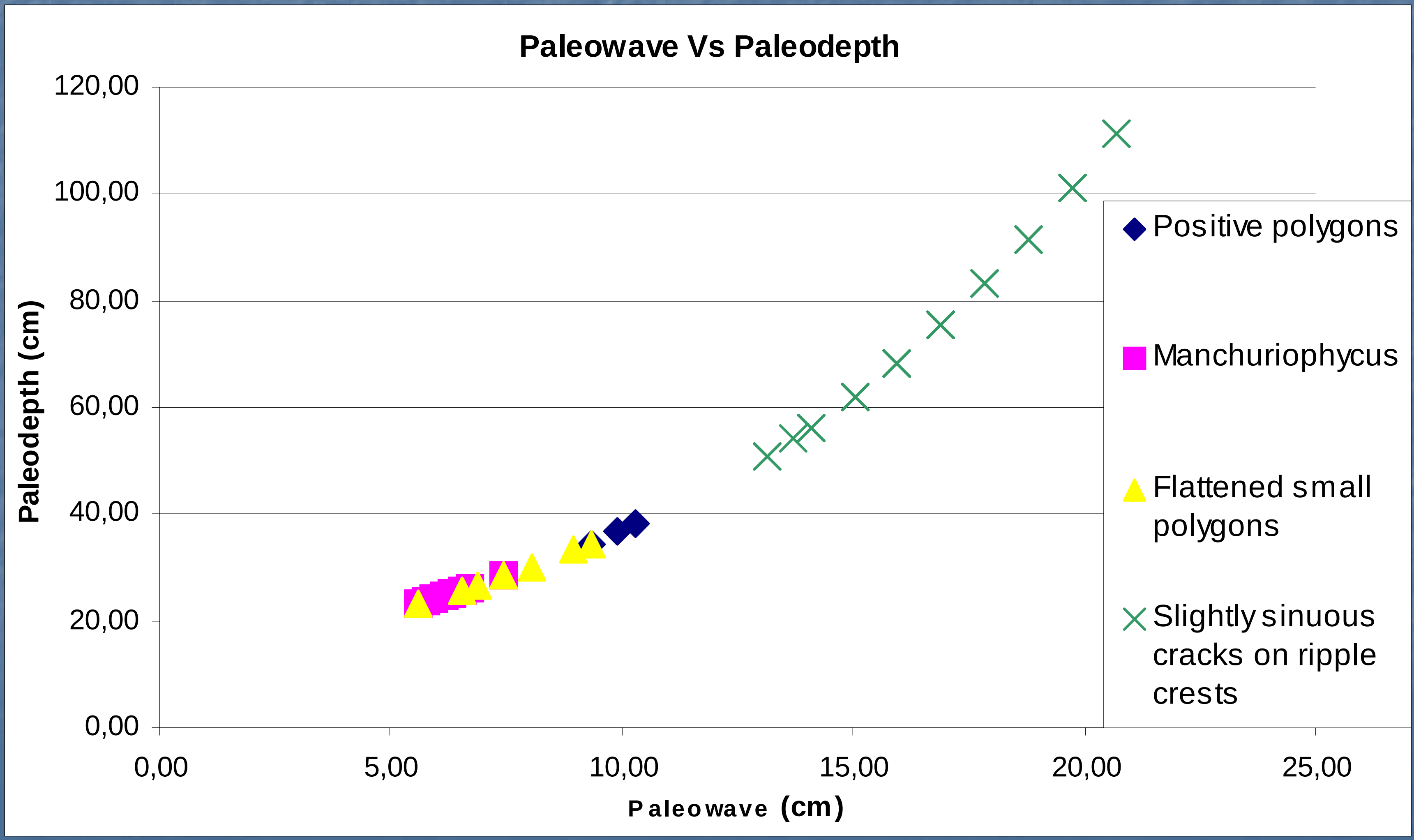
“Healed” sand cracks, “repaired” across cracked microbial mat and resultant curved back crack margins.

Superb example of *Manchuriophycus* cracks in Magaliesberg sandstones



Ripple genesis, epeiric sea shoreline, Magaliesberg Formation – reworking removes all mud

Ripples enable estimation of water depth and wave heights – unusual character of epeiric sea coastlines



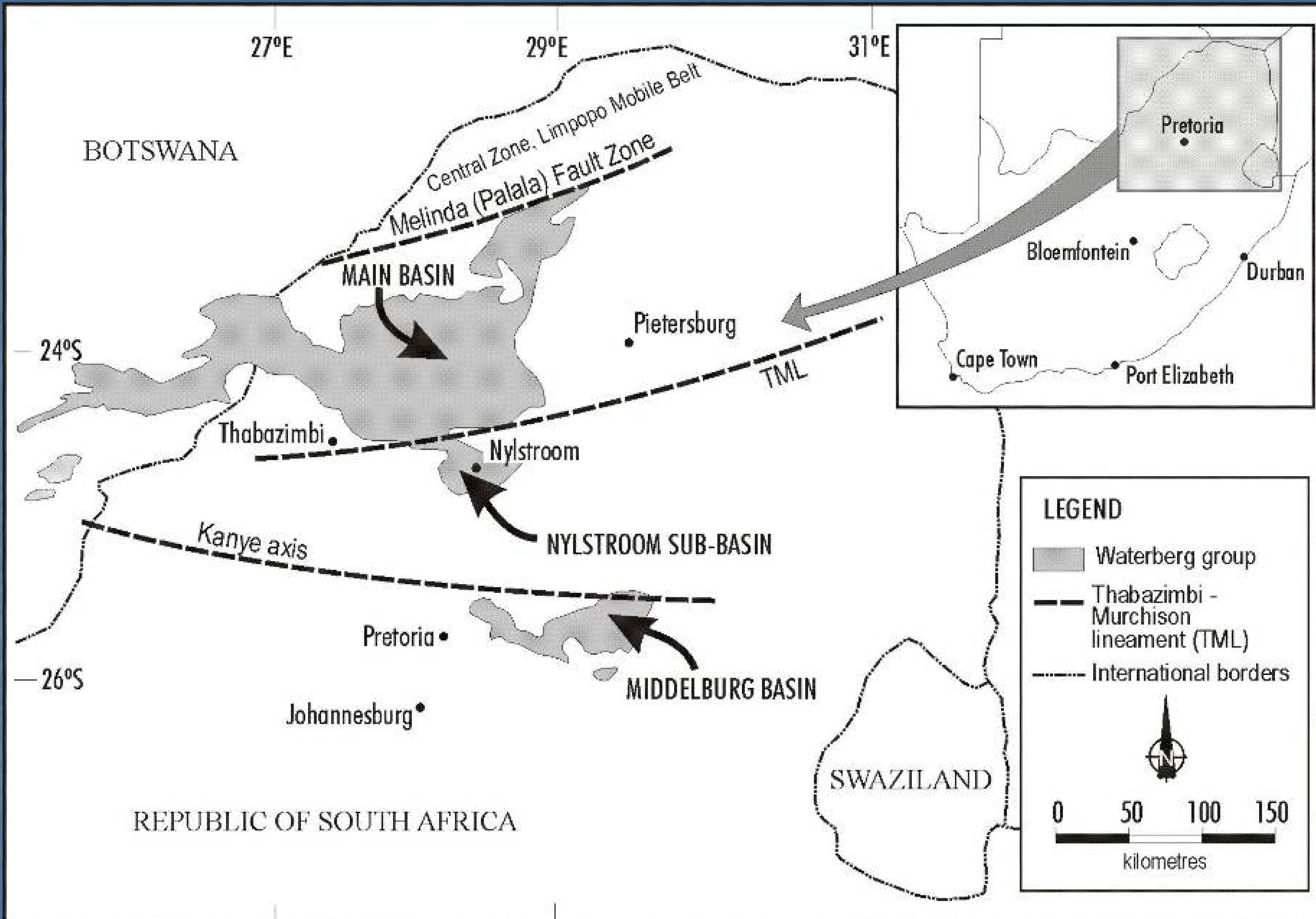
THE WATERBERG GROUP BASINS: EBURNEAN SUPERCONTINENTAL ASSEMBLY

It is probably a mistaken view to interpret the Waterberg basins as BIC-molasse (that is true only for the Loskop trio of formations).
Rather, the Waterberg basins most likely reflect far tectonic effects of the c. 2.2-1.8 Ga assembly of the Eburnean supercontinent, related also to Limpopo Belt reactivation.

Palaeohydrological data from the c. 2.0-1.8 Ga Waterberg Group, South Africa: a possibly unique Palaeoproterozoic fluvial style?

As stated earlier, many Palaeoproterozoic basins contain two major facies-associations – epeiric marine deposits (central basin and coastline) and very large and unusual braided river systems.

We investigated the first under the Pretoria Group, Transvaal Supergroup., and now examine the second, through the Waterberg basins

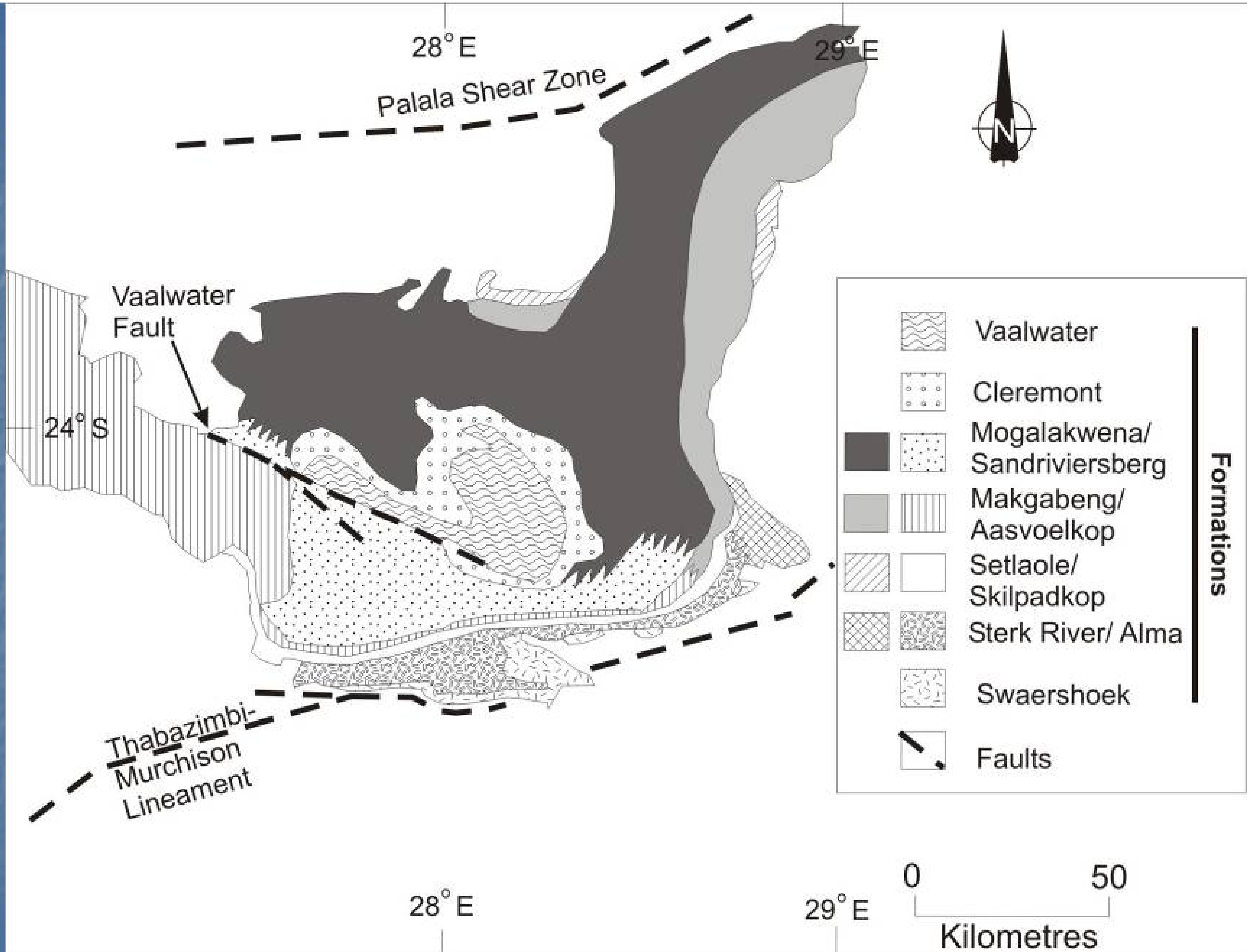


The Waterberg basins of South Africa: ca. 2.0 – 1.7 Ga

The Waterberg Group, Kaapvaal craton includes some of the first red beds (*sensu stricto*) and large erg deposits worldwide, at c. 2.0-1.8 Ga.

This period was also marked by large-scale changes in the supercontinent cycle, sedimentary palaeoenvironments and atmospheric composition.

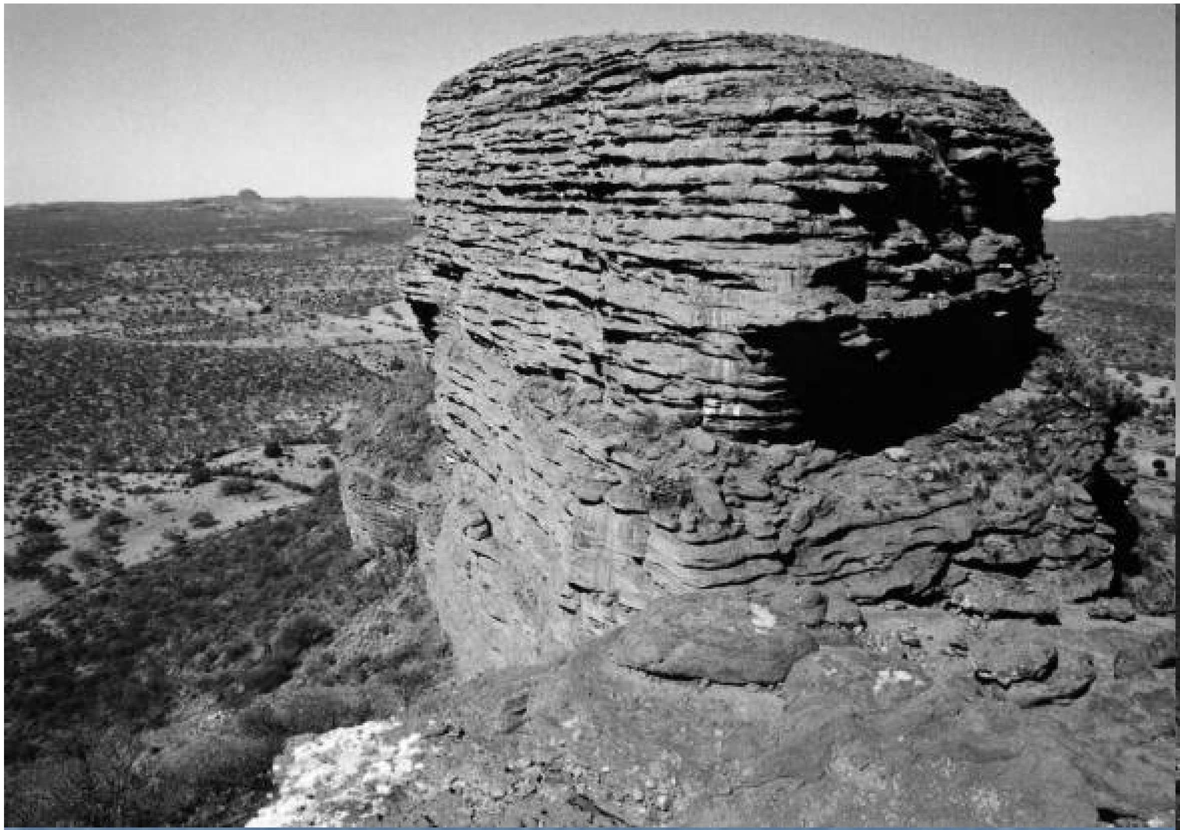
Deposition of the Waterberg Group was largely fluvial, with lesser alluvial, lacustrine and palaeo-desert settings (Simpson et al., 2002, 2004). It is generally accepted that fluvial systems in the vegetation-free Precambrian had a predominantly braided style.



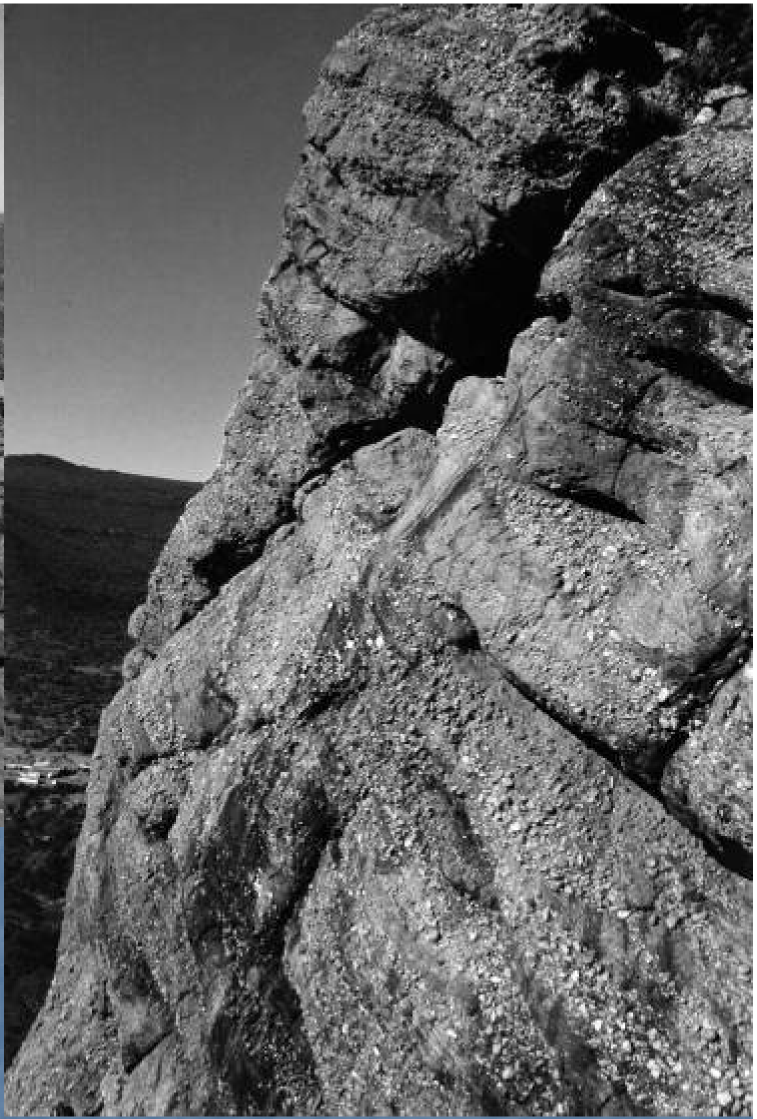
Stratigraphy of the Main Waterberg Basin


The Waterberg erg (sandy desert), amongst
Earth's first deserts at ca. 1.8-2.0 Ga

Braided rivers are low sinuosity multiple channel systems

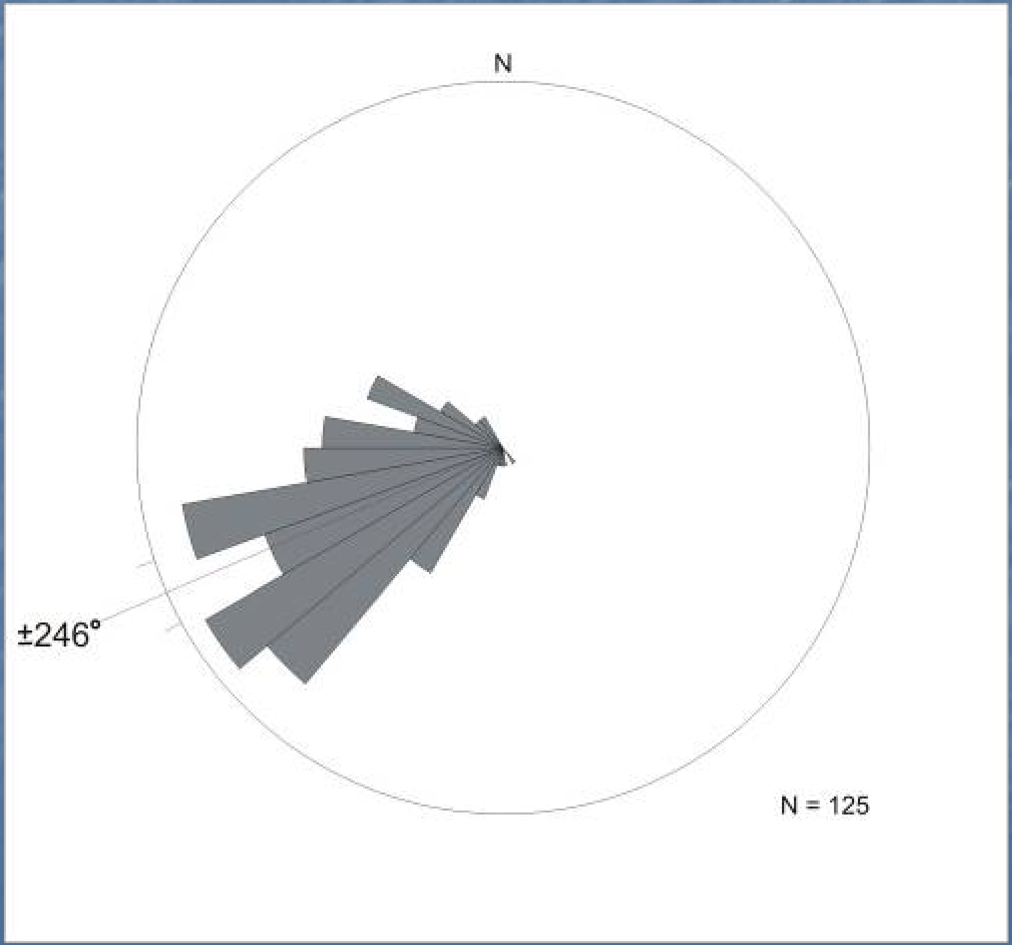


Typical interbedded conglomerate and sandstone-granulestone sheet-like architectural elements of the Mogalakwena Formation. Cliff height ca. 200m.



Close-up of sheet-like architecture. Cliff height ca. 10 m.

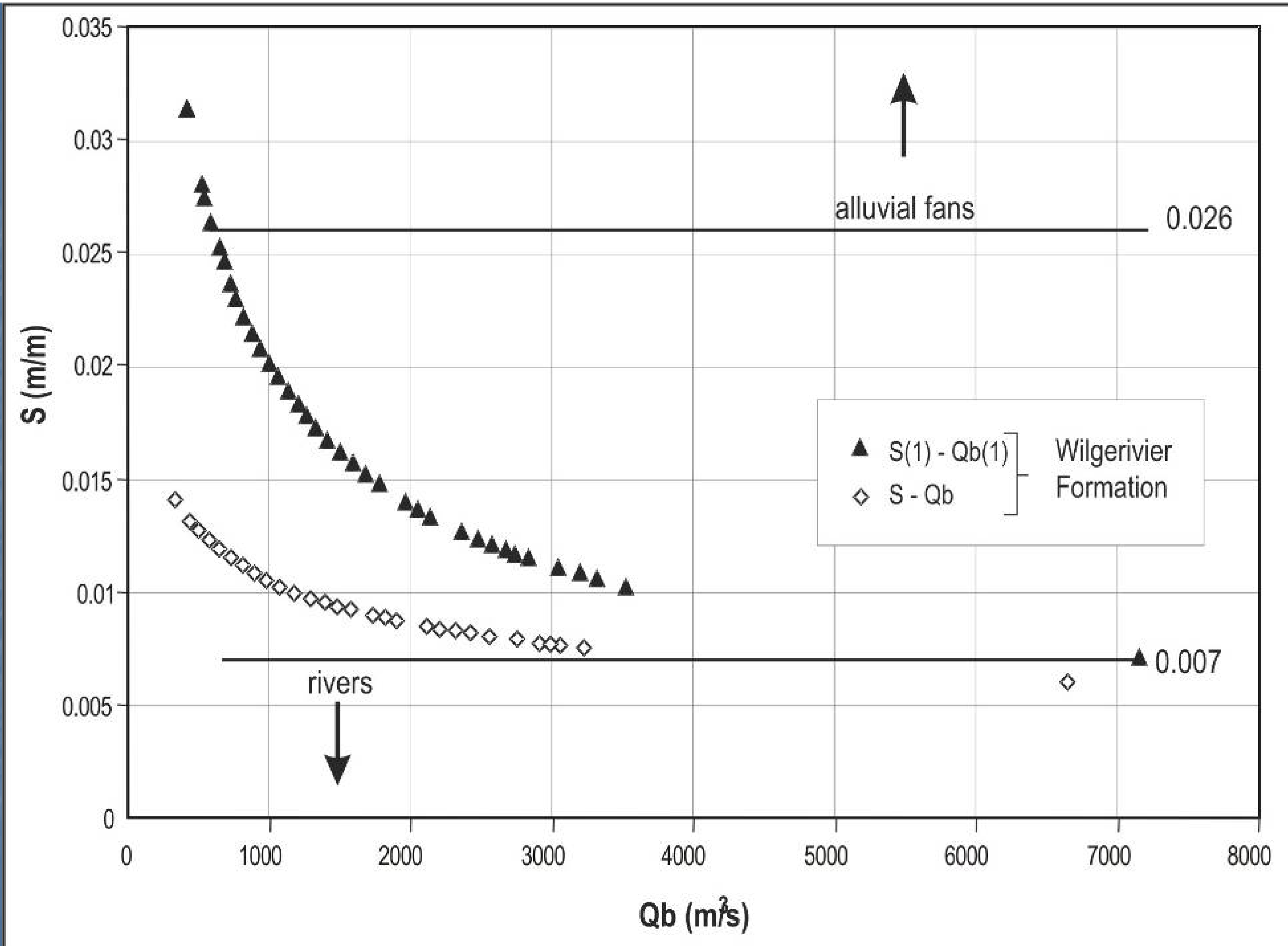
Consistent palaeocurrent pattern supporting braided fluvial system (and not fans), eastern Mogalakwena outcrops



Matrix-supported conglomerates, with well rounded quartz/quartzite cobbles/pebbles; matrix is coarse sand and granules.

Palaeohydrological results from the Mogalakwena Formation show anomalous palaeoslope data, with lying essentially between the gradient limits of 0.007 m/m (maximum for rivers) and 0.026 m/m (minimum for alluvial fans; both defined by Blair and McPherson, 1994).

In this formation thus, typically braided fluvial facies predominate, with concomitant unidirectional palaeocurrent trends, but with subordinate occurrences of sediment-gravity flow and sheetflood deposits recording the influence of raised palaeoslopes, possibly restricted in time and space. The relatively high-palaeoslope conditions of fans contrast strongly with the typically lower-flow-regime channel-floodplain facies of rivers; in the latter, also, sediment-gravity flows are rare.



Palaeoslope values for typical Waterberg fluvial formations: between maximum known for rivers and minimum determined for alluvial fans

Warm and humid palaeoclimatic conditions are inferred for much of the Palaeoproterozoic and enhanced weathering produced an abundance of fines in alluvial systems. It is thus postulated that debris-flow and hyperconcentrated flow processes occurred within Palaeoproterozoic gravely river systems, consequent upon raised levels of fine material being carried by proximal fans.

At least at the local scale if not regionally, the debris-flow and hyperconcentrated sheetflood-type transport required elevated palaeoslopes; these inferred flow characteristics of Precambrian rivers may go a long way towards explaining the apparently higher palaeoslopes calculated for the three Waterberg formations detailed here.

A model similar to the Precambrian Kuujjua River of Canada is postulated, with temporary storage of considerable amounts of muddy sediment in “mud-playas” (cf. Rainbird, 1992) which became reworked in episodic massive flood events.

Braidplains of the Waterberg – huge, probably episodic river systems

GENERAL CHARACTER OF THE BASINS AROUND PRETORIA

They suggest, both in the rivers on the cratons (cf. plates) and in the epeiric seas which advanced onto those cratons, an essentially episodic sedimentation regime, and thus an episodic palaeoclimate.

An episodic palaeoclimate is compatible with the generally dry and stable climatic conditions to be expected under a greenhouse (rich in CO2) atmosphere.

PART FOUR: THE PRESENT STATE AND FUTURE PLANS OF THE DEPARTMENT (plumes and plates forever, with a thought for basins now and then)

HOW WE SEE OURSELVES

The home of Bushveld Geology, Engineering and Hydrogeology in South Africa. Lightheartedly, essentially everything of geological consequence north of the Jukskei River belongs to us.

We fully endorse maintaining professional and ethical values in our teaching activities, research practices and community engagement. We regard it as our duty to strive to produce graduates at all levels who are not only fully trained Geoscientists but also fully rounded human beings with integrity.

Vision

To be the most <u>respected</u> Geology Department on the African continent

RESEARCH FOCUS AREA #1: "BUSHVELD" GEOLOGY

We have a long and proud tradition of studying the world-famous Bushveld Igneous Complex (and related layered mafic intrusions globally), host to the world's greatest resources of platinum group elements, chrome and vanadium. In-depth training in Mineralogy (enhanced by an MSc degree in Applied Mineralogy) is another cherished tradition, supported by the excellent analytical facilities and personnel within the Department (XRF, XRD and electron microprobe). Work on the platinum group mineralogy of the Bushveld and other intrusive bodies worldwide helps to tie these two themes together.

The approach will be essentially holistic, taking account of the Transvaal Basin into which the Bushveld intruded as well as the Waterberg Basins which succeeded it, and looking particularly at the tectonic and structural setting of this great intrusion, its metamorphic effects on both roof and floor rocks, and encompassing also supporting exploration for its rich ore deposits.

RESEARCH FOCUS AREA #2: APPLIED GEOLOGY

Engineering geological properties of soils and rocks, rock slope stability in open cast mines and the influence of geology on the Gautrain tunnels are aspects covered in engineering geological research.

Research in hydrogeology, including the characterization of pollution and groundwater flow into mines, the characterization and sustainable utilization of fractured aquifers in crystalline rocks as well as the vulnerability of karst aquifers, is contributing to the safeguarding of the precious groundwater resource.

The long standing association of the Engineering and Environmental Geology section within the Department of Geology with dolomite stability will be maintained and extended to contribute towards the vulnerability mapping on karst aquifers, especially the surface stability issue if these aquifers are utilized as emergency water supply sources.

RESEARCH FOCUS AREA #3:
Benfield Natural Hazard Centre, Africa

The Benfield Natural Hazards Centre Africa, has been created by the Benfield Group and the University of Pretoria, to provide expert opinion, consultancy and research on natural hazards in Africa and neighbouring territories. The Centre concentrates on earthquake hazard modelling, mining catastrophe, flood and meteorological risk, and can offer independent advice, opinion and analysis on all aspects of African natural perils.

RESEARCH FOCUS AREA #4: Geodynamics

- Geodynamics (= combination of structural geology, basin analysis, crustal evolution and seidmentology)
- Focused particularly on the Bushveld Complex, the Transvaal Basin at its floor and the Waterberg Basins in its roof
- Economic potential of Transvaal-aged basins, including the Iron and Manganese deposits of the Griqualand West depository
- Basin analysis of Karoo-aged coal-bearing basins north of the Main Karoo Basin

World Class Analytical Facility

Temperature- and atmosphere-regulated X-Ray Diffraction Unit purchased in 2005 with support from METFUND - Cost: R1.35 m

World class XRF laboratory

State of the art electron microprobe purchased in 2004 for R 5.9 m

Computerised thin sectioning facility purchased in 2006

21 new student microscopes purchased in 2004 for R 1.5 m; 20 more purchased in 2006 for R 1.63m

Last but not least, two irreplacible people: Wiebke Grote (LC de Villiers Museum curator, left) and Melinda de Swardt (Departmental administrator)

At the end of the day, it is all about getting the students on to the rocks– making them into professional scientists and better human beings

Some people are better at this than others...

Brother Leader teaching Hilaire Diarra the rudiments of the field communications code