

African geology, the Bouvet mantle plume and the early opening of the Gondwana margins



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The work forms part of IGCP-628 - the Geological Map of Gondwana - at the Federal University of Rio de Janeiro.

1.National...

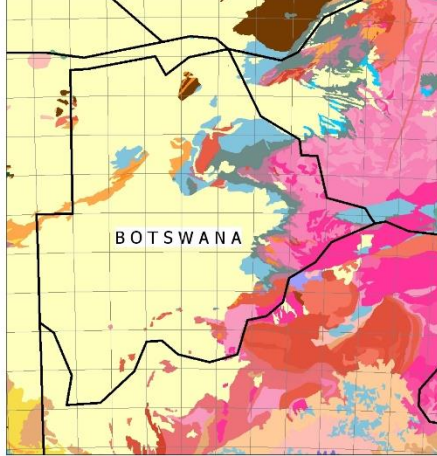
The solid geology of many parts of Africa is hidden below 'cover' formations, such as the Kalahari sand in Botswana (*right*).

Aeromagnetic surveys of entire countries (*far right*) have been employed widely in the past 50 years to reveal hidden structures and lithologies in support of national resource-development strategies.

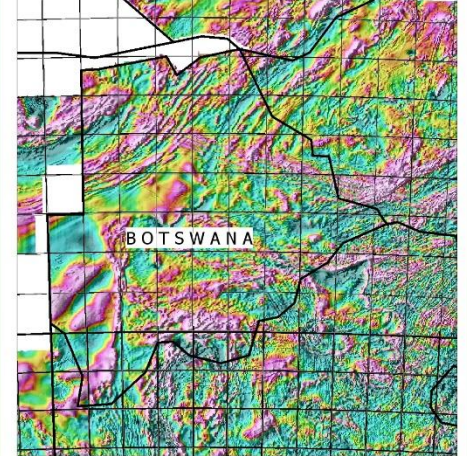
2.Continental...

Little attempt has been made until now to correlate geological interpretations across the 16 countries of eastern and southern Africa (*below*). Features revealed include the Okavango dyke swarm (**A** -178 Ma), The Morokweng meteorite impact (**B** -145 Ma, J-K boundary) and the Mwembishi trans-Africa dextral shear zone (**C** - 135 Ma).

0.00 Ma :: CR20AAAW :: Botswana Geology :: 2020 March 4



0.00 Ma :: CR20AAAW :: Botswana Aeromagnetics :: 2020 March 4

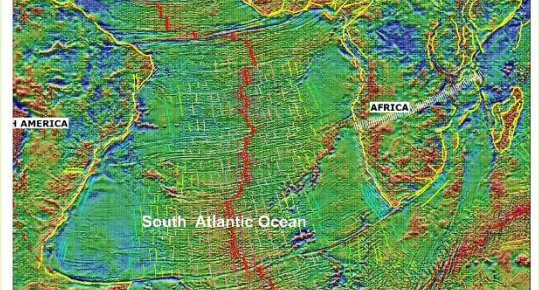


3.Oceanic...

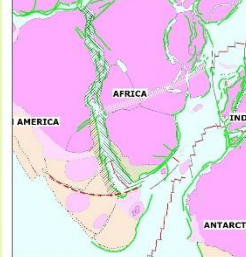
Fracture zones on the ocean floor, revealed by satellite altimetry (*right, top*), define the path by which continents separated. Timing is provided by the marine geomagnetic reversal anomalies - where available! Gravity anomalies lying offshore separate true oceanic crust from stretched continental crust and the undeformed continental crust itself.

Closing' the oceans by matching these offshore anomalies leaves a 100 +/- 50 km wide strip, originally occupied by pre-rift (i.e. not stretched) continental crust (*below right*) that later became stretched to about half thickness (*below left*).

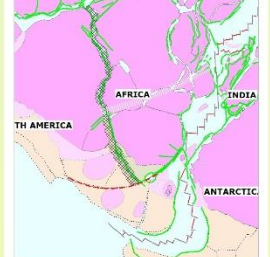
0.00 Ma :: CR20AAAW :: Ocean FZs and isochrons :: 2020 March 3



130.00 Ma :: CR20AAAW :: Stretched margins :: 2020 March 3



145.00 Ma :: CR20AAAW :: Stretched margins :: 2020 March 3



0.00 Ma :: CR20AAAW :: Aeromagnetic Interpretation E & S Africa :: 2020 March 4



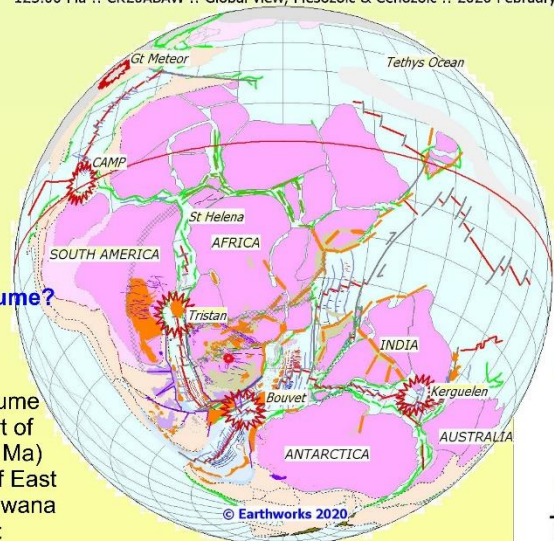
4.Global...

A set of Euler *interval* rotation poles has been determined (1995-2020) in the CPSL 'Atlas' software to drive a refined model of Gondwana dispersal. The Precambrian fragments used in the model are shown in the Gondwana assembly (*right*).

200.00 Ma :: CR20AAAW :: Precambrian Africa in present-day location :: 2020 March 2



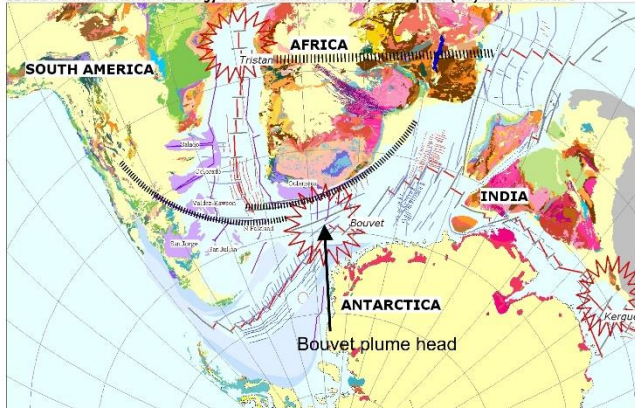
125.00 Ma :: CR20ABAW :: Global view, Mesozoic & Cenozoic :: 2020 February 27



The Bouvet plume?

Gondwana continents still surround the plume head at the start of the Aptian (126 Ma) as disruption of East and West Gondwana gets under way: geology (*left*) and global view (*right*).

126.11 Ma :: CR20ABAW :: Geology of Gondwana continents, start Aptian (M0) :: 2020 March 5



Watch the animations on your i-Phone at www.reeves.nl/gondwana

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Fifty years of detailed geophysical mapping of Africa's hidden geology (in support of logical resource development policies) has revealed many continental-scale features of global significance. These include one of the world's largest dyke swarms (Okavango, 178 Ma), the Morokweng meteorite impact (145 Ma, Jurassic-Cretaceous boundary) and new intra-continental rift systems and shear zones (135-128 Ma). In the context of the new geological map of re-assembled Gondwana (IGCP-628) this has led to a refined model of Gondwana break-up and dispersal in Jurassic and Early Cretaceous times. Essential to the geodynamic model is interpretation of ocean-floor topography derived from satellite gravimetry in conjunction with sparse marine magnetic anomaly data from before the Cretaceous Quiet Zone (84-126 Ma). The ongoing role of the Bouvet mantle plume emerges as the central theme to this process, from the initial large igneous province (circa 183 Ma), through a ridge reorganisation at 135 Ma to the eruption of the Iceland-like Agulhas plateau basalts at about 100 Ma, as well the subsequent history of the associated triple junction. Whereas the outbreak of the Tristan plume (135 Ma) is often given credit for the opening of the South Atlantic Ocean, the more southerly parts of the proto-ocean were manifestations of pre-135 Ma Bouvet plume activity. The geodynamic model is illustrated by animations, also available on the website www.reeves.nl/gondwana. Delineation of sub-plates within the Patagonia region of South America remains enigmatic.

120.00 Ma :: CR20ABAD :: IGCP-628 :: NAC 2020 :: 2020 January 10

