Zeitschrift: Bulletin der Vereinigung Schweiz. Petroleum-Geologen und -Ingenieure

Herausgeber: Vereinigung Schweizerischer Petroleum-Geologen und -Ingenieure

Band: 46 (1980-1981)

Heft: 111

Artikel: Continental drift in the South Atlantic : oil geological implications : the Malvinas Basin

Autor: Schroeder, J.W.

DOI: https://doi.org/10.5169/seals-204697

Bull. Ver. schweiz. Petroleum-Geol. u. -Ing., Vol. 46, Nr. 111, Oktober 1980, p. 57 - 70

Continental drift in the South Atlantic: Oil geological implications: The Malvinas Basin

by J.W. Schroeder*

There are still several unexplored sedimentary basins either onshore or offshore: between the Falkland Islands (or Malvinas Islands) and South America there is one of these undrilled basin: The West Malvinas Basin. The theory of continental drift help us to outline its probable geology, but to write about continental drift in the South Atlantic after such giants as WEGENER, DU TOIT and MAACK, may appear presomptuous. However, lately, many studies have been performed and, as all tend to confirm beautifully the parting of South America from Africa, we feel authorized to make use of these studies to elucidate the consequences of continental drift on the oil geological conditions of the area. With twelve figures we try to present the problem:

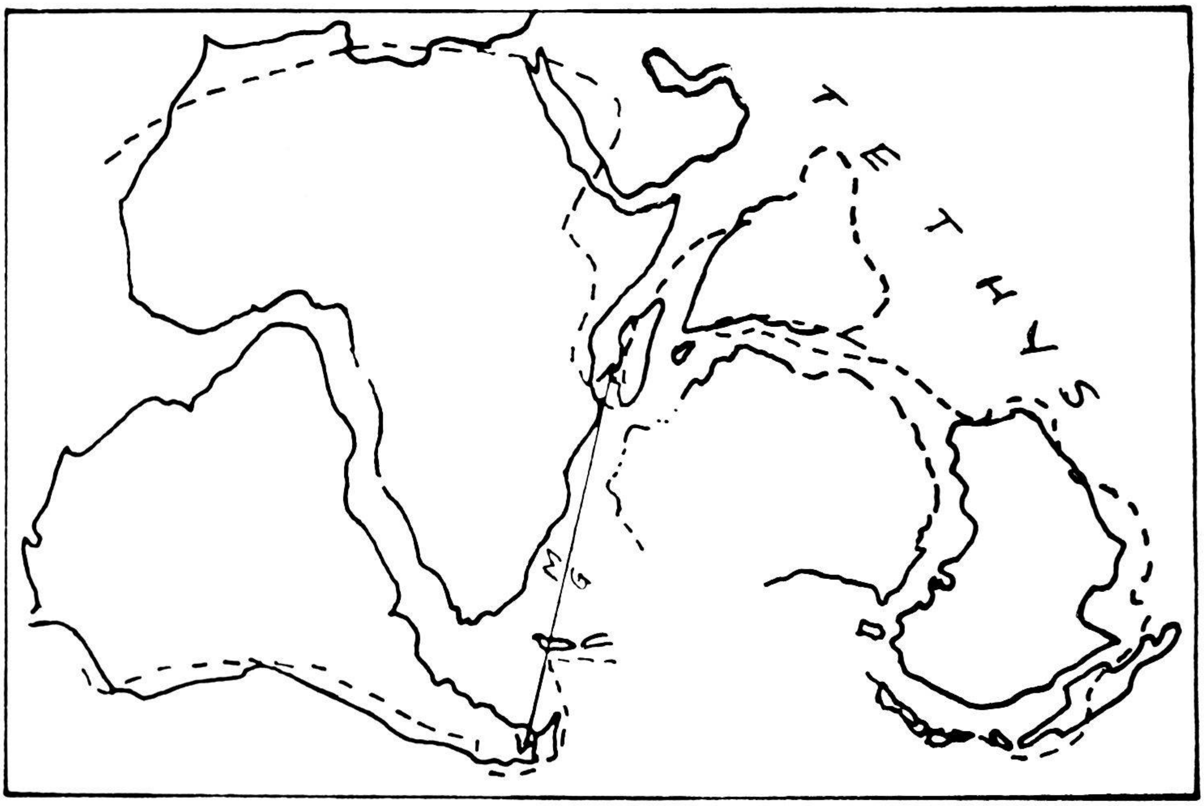

Fig. 1 Margins of Gondwana during Early Jurassic. MG = Madagascar-Patagonia through! (DU TOIT, 1937, p. 98).

* Jean William SCHROEDER, Dr. ès sciences, géolgue, 1, route de Drize, Genève

Figure 1 reproduces the conception of DU TOIT in 1937: it will be noticed that this author already had conceived a marine trough linking Patagonia with the strait separating Madagascar from Africa.

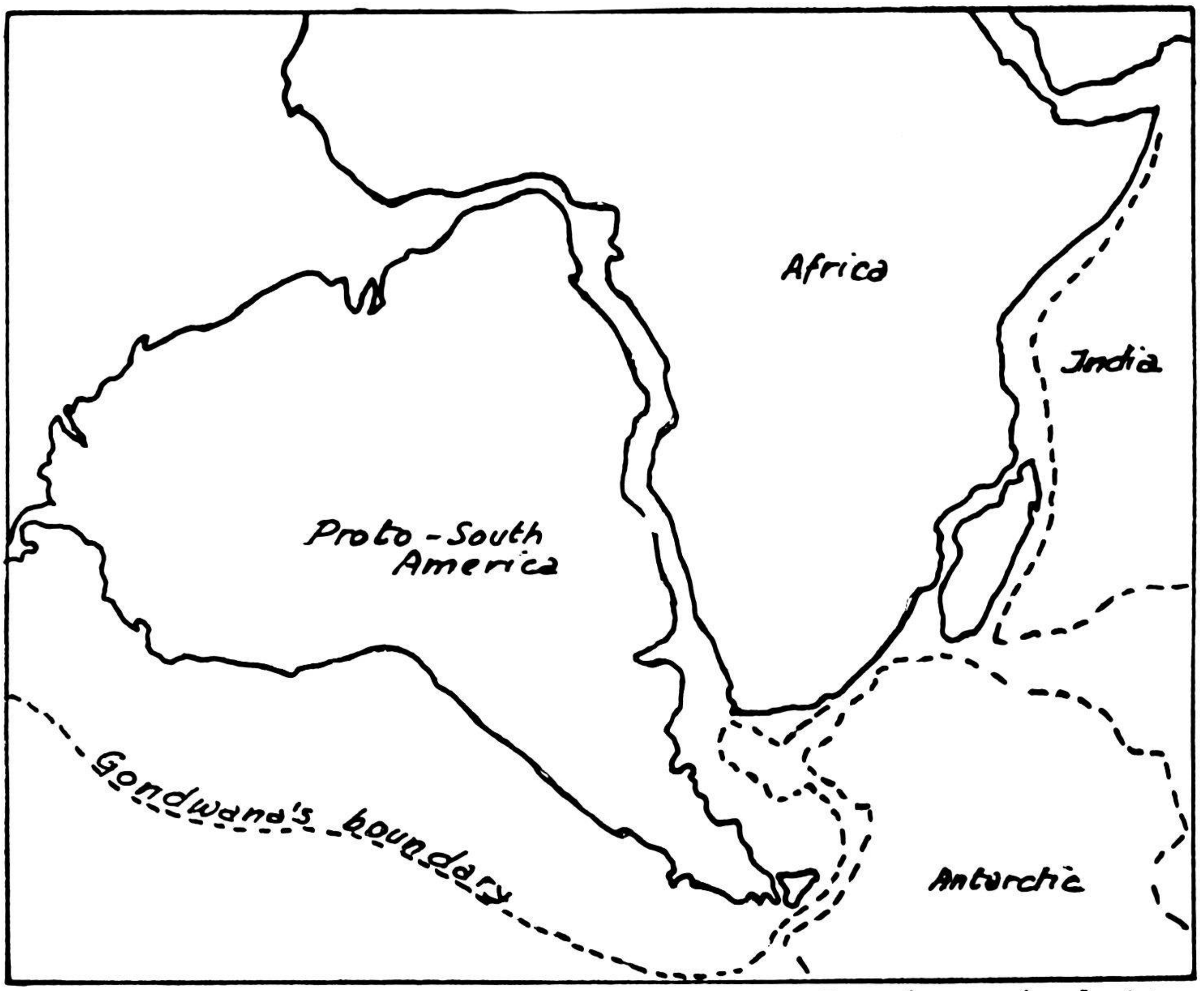

Fig. 2 Gondwana boundaries at the Beginning of the Mesozoic, after MAACK 1952.

MAACK in 1952 *(Fig. 2)* already places Madagascar much further south than the original wegnerian positions and Antarctica is placed alongside the area of Durban in South Africa. The same author *(Fig. 3)* in his extraordinary 1969 publication, exposes his conceptions on the relative past positions of the present continents of the Southern Hemisphere during the Mesozoic; in Maack's reconstruction it will be noticed that a Jurassic Indian Ocean was located between Antarctica on one side and Africa/S. America on the other side: from this reconstruction it is not clear if the Jurassic Indian Ocean was connected with the Pacific Ocean. In any case, as well as Antarctica as the Falkland Islands were located on the edges of a Jurassic sea. After these pioneer conceptions we come to the conceptions derived from the oceanographic studies (JOIDES, magnetometry, precise bathymetry) of the last fifteen years which have so magnificently confirmed the Wegnerian theory.

Figure 4 reproduces a well known reconstruction of DIETZ & HOLDEN (1970): The break up between Africa and proto-South America on one side and the other pieces of Gondwana is clearly shown for the end of the Triassic times; however we wonder if Ma-

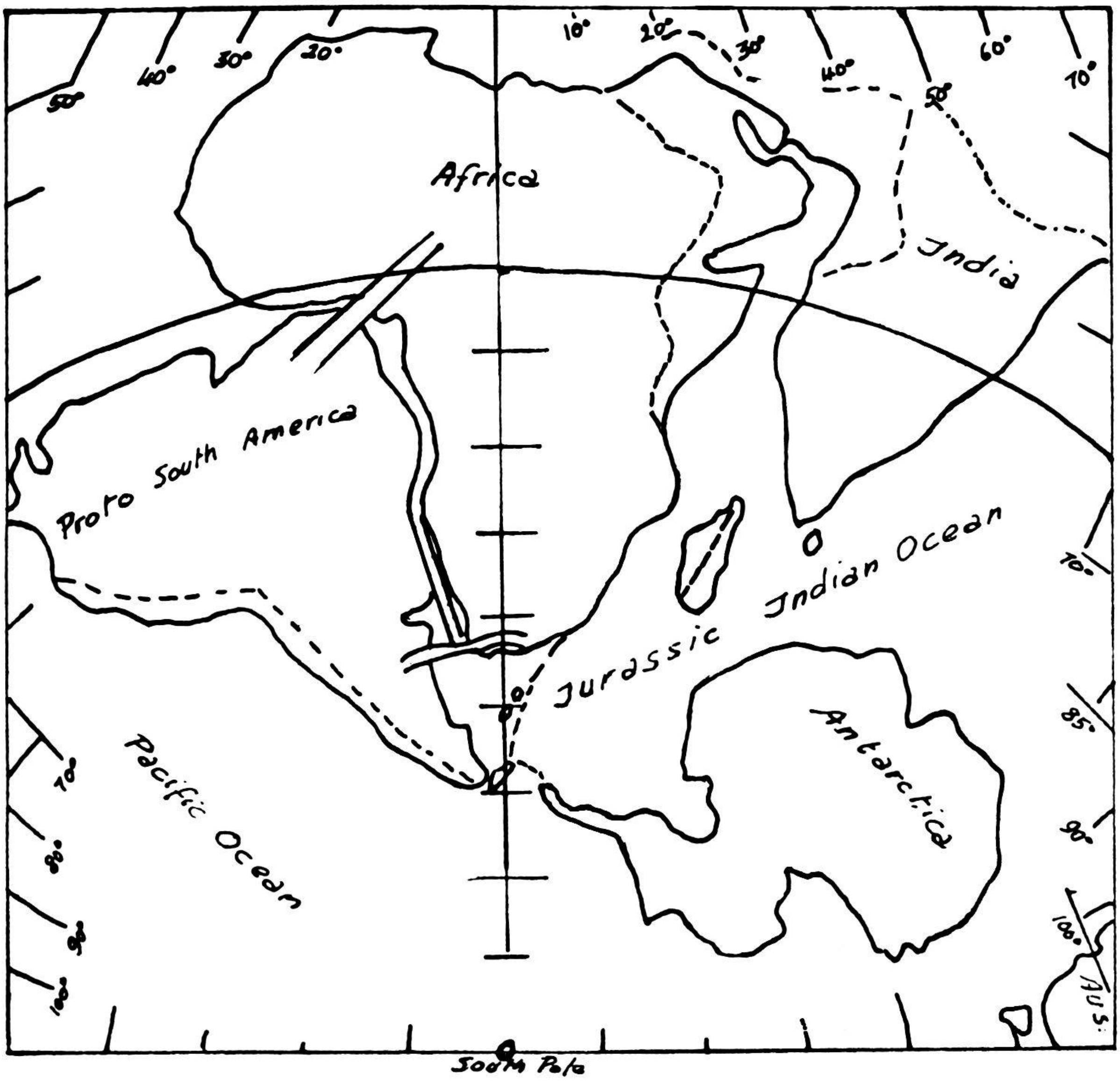

Fig. 3 South Atlantic during the Jurassic. The South Atlantic graben is not yet connected with the Indian Ocean, after MAACK 1969.

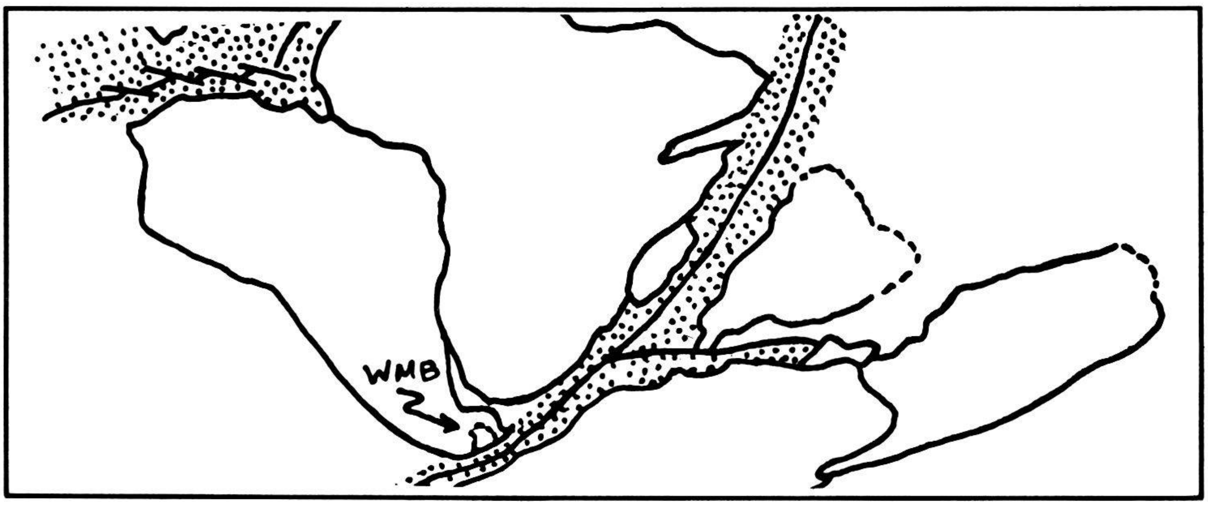

Fig. 4 Palaeogeographic Sketch showing the position of the Malvinas Basin (WMB) at the end of Triassic times. Break up shown by a heavy line. New ocean floor stippled, after DIETZ and HOLDEN 1970.

dagascar was not separated from Africa as marine Permian limestones are known in the western areas of Madagascar. *Figure 6* represents HAMILTON's conception (1964) of the relative positions of the various Gondwana pieces just before the Mesozoic: For the first time care is taken to give a pre-mesozoic fatherland to the Kerguelen and the Seychelles microcontinents. Then in 1973 TARLING *(Fig. 7)* presents a reconstruction of Gondwana based on his extensive paleomagnetic studies.

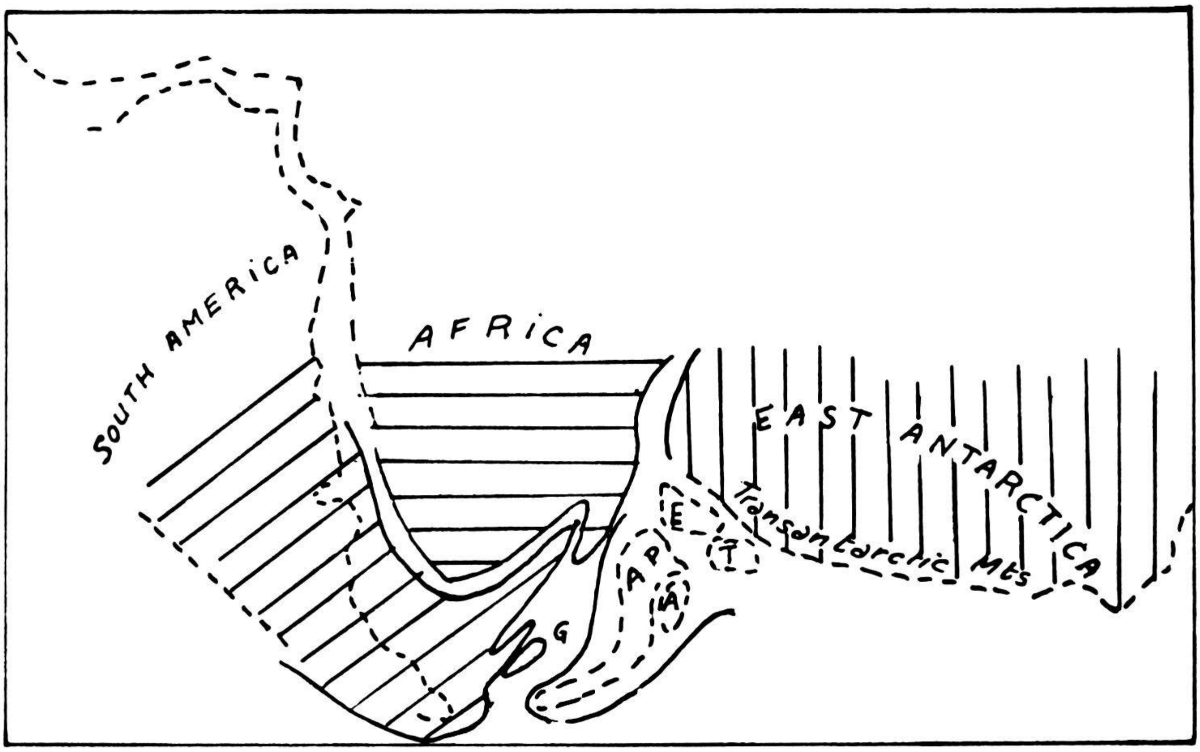

Fig. 5 Reconstruction of Gondwana

G South Georgia microplate, AP Antarctic Peninsula, E Ellsworth microplate,
A Alexander Island, T Thurston microplate.

Note: In this reconstruction the site of Proto Scotia Sea is occupied by microplates! After de WIT 1978 in W. HARRIS, Leg. 36.

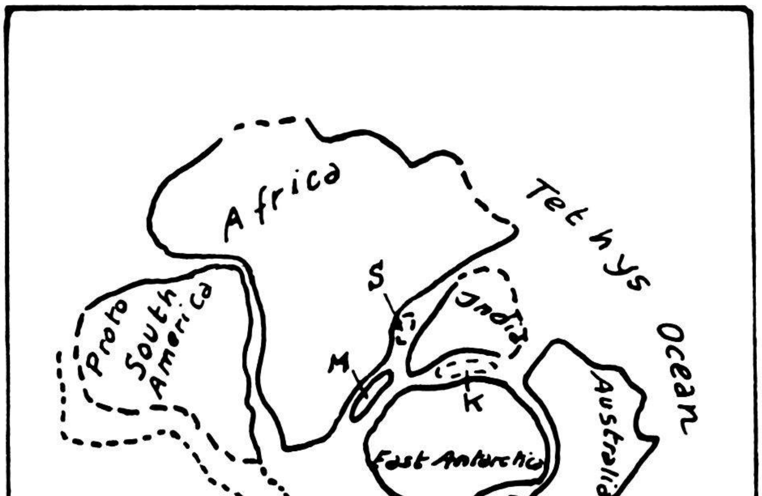

Fig. 6

Gondwana before the Mesozoic

S: Seychelles, K. Kerguelen
W.A: Western Antarctica
M.: Madagscar

after HAMILTON 1964

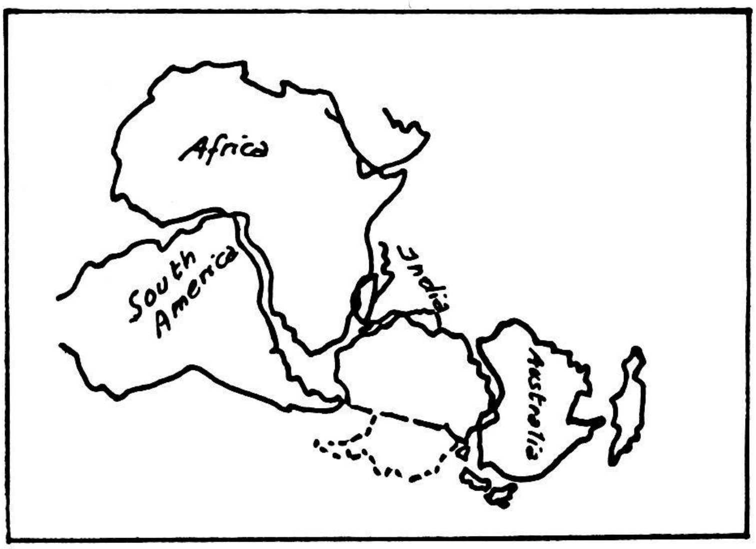

Fig. 7

Gondwana in Early Mesozoic, after TARLING (1973)

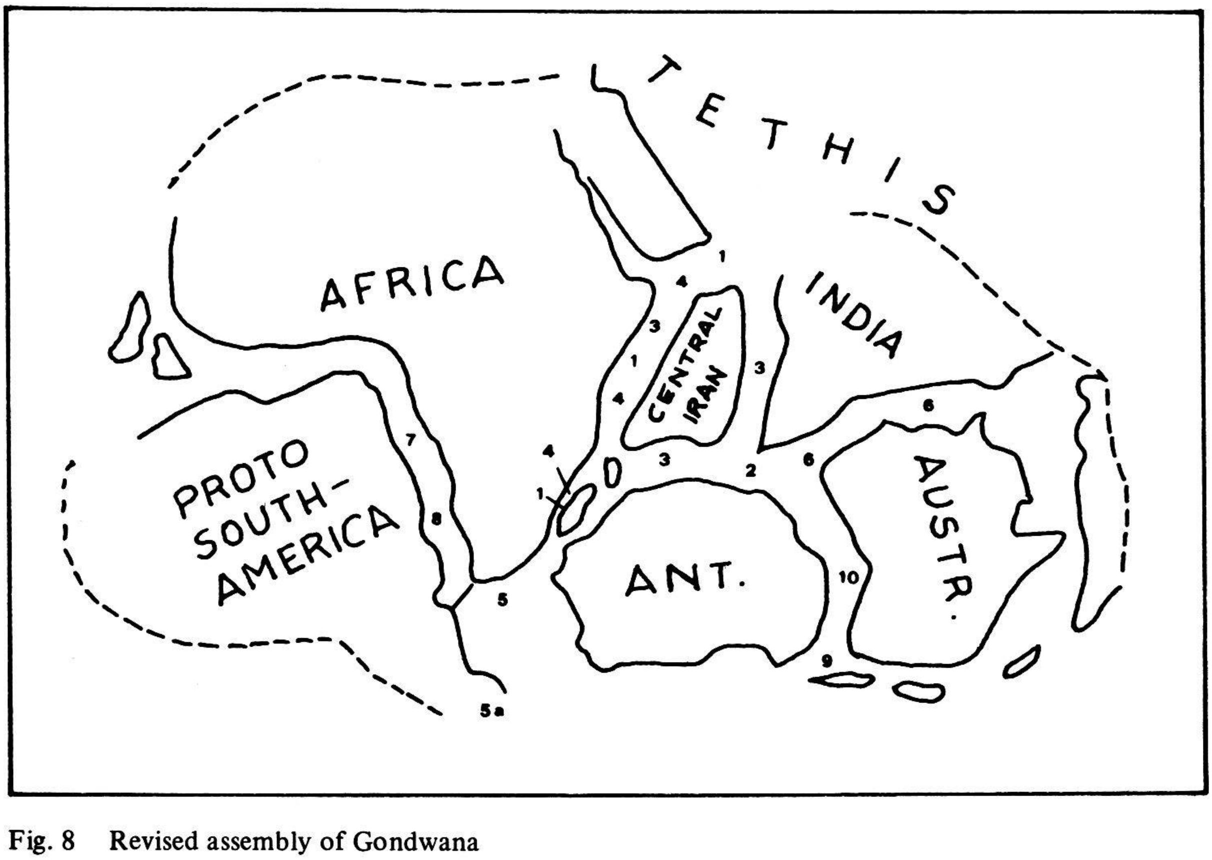

Fig. 8 Revised assembly of Gondwana

1 Permian Gulf
2 Break up of India from Antarctica (225 m.y.): Early Trias (?)
3 Break up of Central Iran from Gondwana: Late Trias (Drift into the Persian Tethys)
4 Jurassic seaway
5 Uppermost Jurassic of Uitenhagen
5a Upper Jurassic of Tierra del Fuego
6 Eastern Gondwana fragmentation: Albian seaways
7 South Atlantic opening (graben): Lagoonal Albian
8 South Atlantic opening: marine Albian
9 Tasman Sea opening (85 m.y.): Coniacian
10 Break up of Australia from Antarctica: (60 m.y.): Paleocene
After L. KING, 1973

Figure 5 is a paleogeographic reconstruction of DE WIT, accompanying the compilation of Leg 36 results: (Leg 36, 1977) in this reconstruction of Gondwana the Falkland plateau (recently oceanographically recognized) is shown adjacent to South Africa, from the Agulhas Bank to the offshore area of Durban: Antarctica is placed against Africa, much to the north of the Mozambique coast and a Proto-Scotia Sea is occupied by several microplates.

Figure 8 is drawn after a figure of L. KING (1973); we added the parting ages taken from his text. KING's reconstruction is thought-provoking because he locates Central Iran, not along the northeastern border of the Arabian peninsula as we have used to do but between India and Africa. SCHROEDER (1946) on the basis of the presence of the Hormuz series in the Persian Gulf and a similar serie in the Salt Range had suggested that India must have lain near the eastern part of the Arabian peninsula; but this was before the discovery of the Hormuz series in Central Iran by our colleague STÖCKLIN. In a still more thought-provoking publication (L. KING 1980) KING suggests a still „revised" version of his 1973 reconstruction in which he locates the Arabian peninsula, north of Central Iran, and also between North Eastern Africa and India. This primitive position of Arabia before a Permian drift towards its more or less present position explains many pecularities of the geology of the Sudanese coast of what should be the Red Sea so-called drift (WHITEMANN, 1965). Such primitive positions of India, Central Iran as well as of the Arabian peninsula agrees with the probable Infracambian paleoclimatology: During the Infracambian there is, within Gondwana*, a Tethys characterized by a Stromatolitic Sea along the equator of this time (PIPER, 1973, p. 21 and 25). Away from this Infracambian equator we find in Central Iran, NW India and Eastern Arabia the very characteristic evaporite Hormuz series, also of Infracambian age. If Central Iran had not lain between India and Africa as L. KING suggest, but north of the Zagros suture, it is difficult to conceive the presence of the desertic areas of the Hormuz series of Central Iran, because this microcontinent should have been located by a paleolatitude of 50° degrees, obviously not in an area where one could find extensive evaporites. On the other side of the Infracambian equator, in proto-South America, in Eastern Bolivia: we observe the passage, today from east to west, that is paleopolewards, of the tropical stromatolitic limestones of the Infracambian to non calcareous sediments. Also in Bolivia, and also further polewards we find what is perhaps an Infracambian evaporitic deposit with the ? Infracambian ? salt of the Limbo Group ** in the eastern Andes, paleolatitudinally symmetrical to the Hormuz serie. The equatorial Infracambian stromatolitic proto-South Atlantic Sea was closed during the Pan African orogeny which gave birth to the West Congolian and Katangan orogens.

Figure 9 is a sketch reconstructing the reciprocal positions of proto-South America and Africa in which the huge Falkland sialic appendix (Falkland plateau) between the Falkland escarpment and the Falkland through is shown adjoining South Africa as well as Madagascar before the break up: The Lemonbo lineament finds its continuation in the eastern part of the Falkland plateau or appendix; the Recife Arch similary find a geological expression in the Falkland appendix, and the Falkland Island Uplift finds its prolongation in the Agulhas Arch, damming in the West the Outeniqua offshore basin. If these reconstruction appears satisfactory, especially the position of Madagascar (after FLORES, 1970) a disturbing feature always remains: it is the straight sialic coast of eastern Madagascar: in none of the reconstructions do we find a straight sialic coast corresponding to the east coast of Madagascar (There is probably another temporarily missing piece of the puzzle).

* from Marocco to Namibia

** Quoted by BROCKMANN (1972) in Bol. Soc. Geol. Boliviana, No 18, p. 9 to 11.

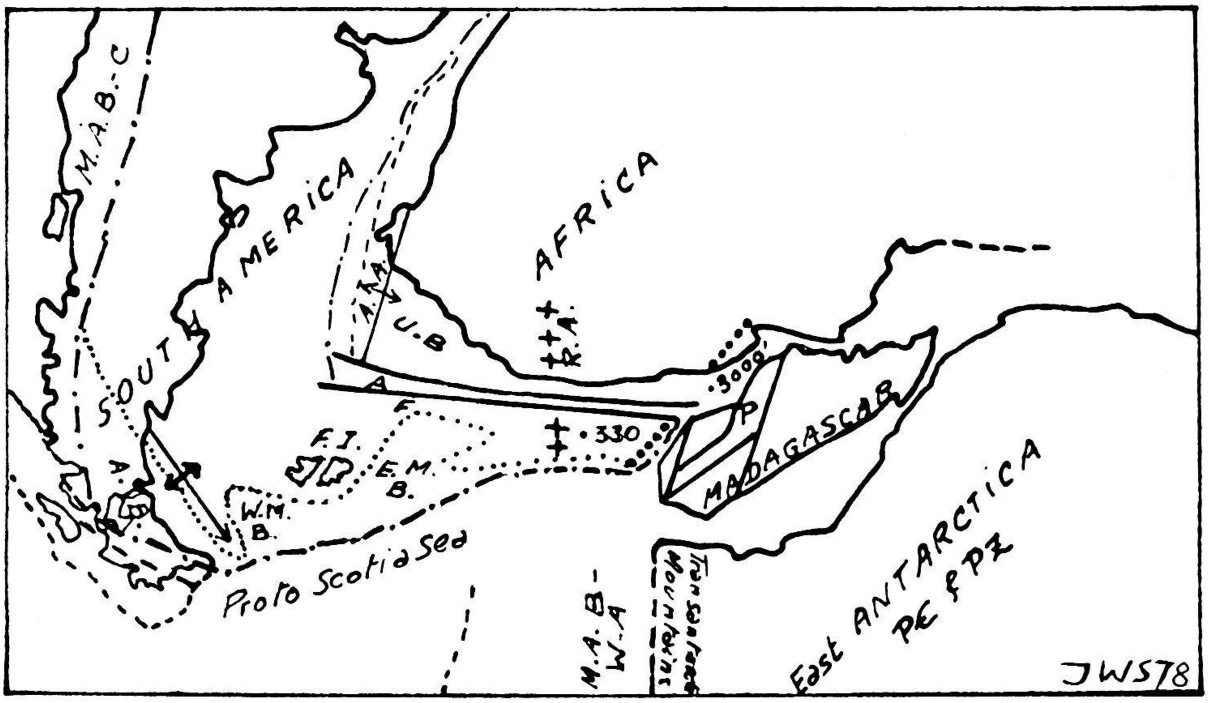

Fig. 9 Sketch showing the reciprocal positions of the Austral and Malvinas basins and of other tectonic features at the beginning of Mesozoic Times.

M.A.B.-W.A.	Mesozoic accretionary Belt of Western Antarctica,		
M.A.B.-C.	Mesozoic accretionary Belt of Chile,		
A.B.	Austral Basin,	U.B.	Uitenhage Basin,
W.M.B.	West Malvinas Basin,		
E.M.B.	Eastern Malvinas Basin,		
F.I.	Falkland uplift,	R.A.	Recife Arch,
F.	Falkland escarpment,	A.A.	Agulhas Arch,
A.	Agulhas Fault Zone,	••••	Lebombo Line,
330:	115 m of Jurassic + 225 m of Callovian to Albian deposited		
3000':	3000' of marine Liassic deposited	P.	Marine Permian

Madagascar position after FLORES (1970), Antarctic position after DIETZ (1973),
_._._. South America boundary

While drifting, during the last 127 million years, away from South Africa along the Falkland-Agulhas Fault, the meridional segment of South America took the shape of a huge boot, hitting backwards, the heel being the Tierra del Fuego, and the sole the Falkland through. On *figure 10* are sketched the successive mesozoic positions of proto-South America progessively drifting towards the Pacific. If in the South, proto-South America was sliding along the Agulhas Falkland fault, and the Falkland through fault, in the north (of the South Atlantic) this continent was sliding along the Romanche fault. And, as long as the Brazilian sialic crust was sliding along the Eburnean sialic crust of the Gold- and Ivory Coasts, no connection between South Atlantic and North Atlantic was possible. It is only during the Campanian, and fully during the Maestrichtian, that the waters of North and South Atlantic (BEURLEN 1970, p. 256 + 257), and hence the faunas of North and South Atlantic could mingle. One is tempted to compare this westwards sliding of proto-South America along these two majors faults (Romanche in the North and Agulhas-Falkland in the South, with the northwards sliding of India between the Owen and Ninety East ridge fractures.

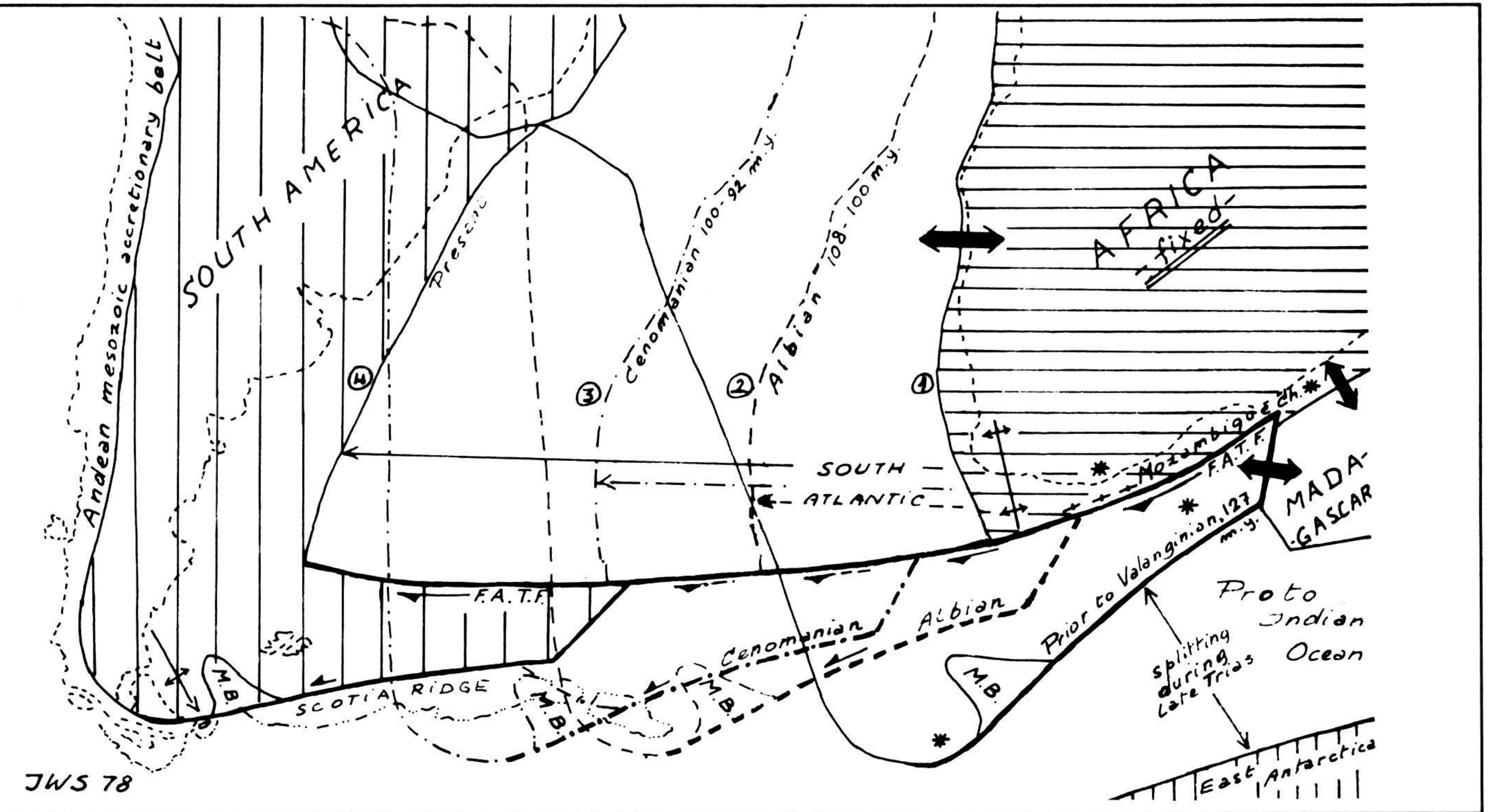

Fig. 10 Southern South America Drift

— + — + —	Agulhas marginal ridge
M. B. =	West Malvinas basin
F.A.T.F.	Falkland-Agulhas Transform Fault
Fast spreading from 100 to m.y	
source rocks deposition from 145 to 110 m. y	

S. America positions relative to Africa fixed:

- ④ ——— present
- ③ —·—·— assumed during Cenomanian
- ② — — — assumed during Albian
- ① ——— prior to Valanginian: prior to magnetic anomaly M 12, 127 m. y

⟷	Emplacement of suboceanic ridges: Mid Atlantic, Transkei + Mozambique
*	Sites of Upper Jurassic marine sediments
Mercator projection	480 miles

If the Agulhas Falkland fault is a transform fault, the fault separating proto-South America to the south (between the Foothills Belt an the Patagonian eugeosyncline) and marked by the Malvinas through South of the gravity low of the Foothill belt is in reality a former atlantic type coast which evolved in a wrench fault between an oceanic floor and a sialic crust, the true nature of which is camouflaged by an overthrust (Burdwood Bank) towards the north, of a patagonian material (ophiolites and deep sea deposits). Further south of the Patagonian former eugeosyncline is the present oceanic floor (the northern limit of which is marked by the southern extension of the smooth magnetic anomalies) (Oligocene ?) to Miocene age, created after the static interval of the Paleogene, and more or less contemporaneous with the recent drift episode.

The West Malvinas Basin has been surveyed by refraction seismic (LUDWIG 1968), and is now a well established tectonic feature between the Falkland Island Uplift and a Bahia Grande Arch *(Fig. 11).* These two tectonic units terminate abruptly in the South against the Malvinas through wrench fault. The West Malvinas Basin is tectonically in a symmetrical position with the Maracaibo Basin in the north of South America, this one limited in its nothern part by the Ocoa right lateral wrench fault, which plays the role of the Malvinas trough left lateral wrench fault.

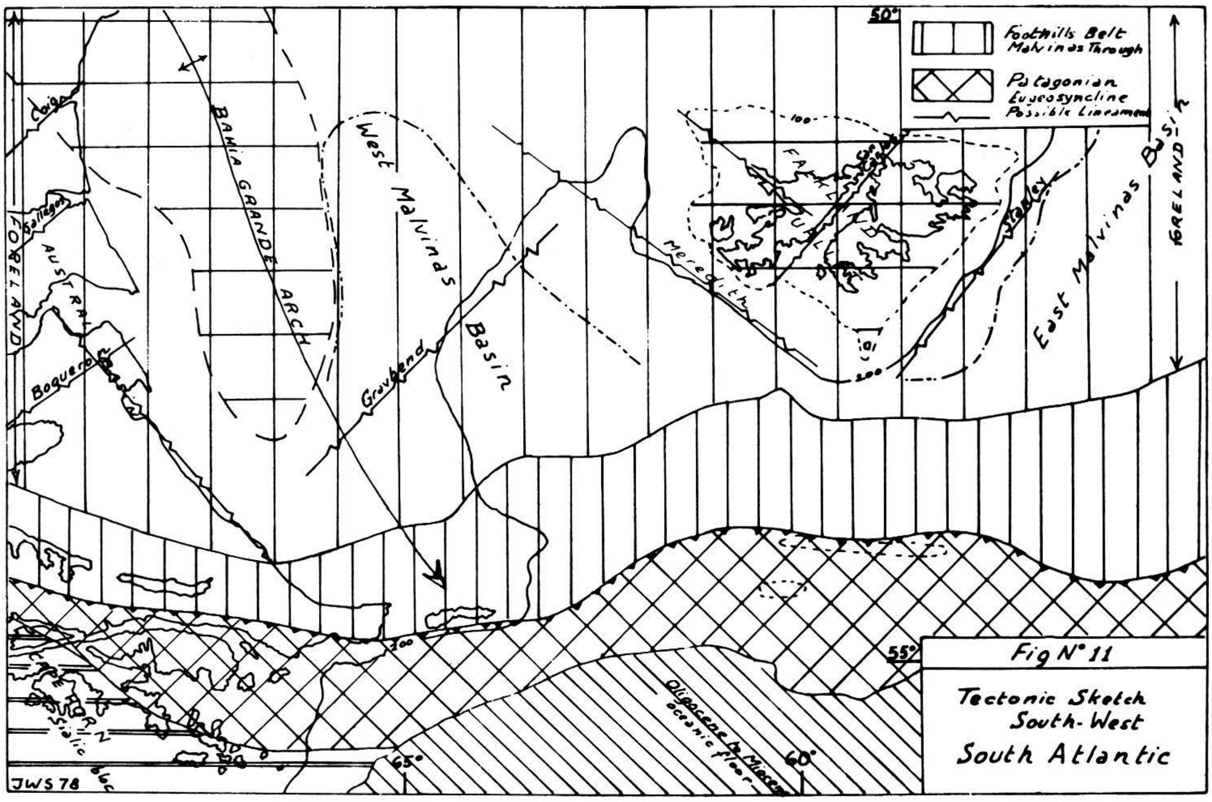

Fig. 11 Tectonic Sketch, South West-South Atlantic

The sedimentary nature, of the West Malvinas basin although suspected since long time, has been confirmed by a first seismic refraction survey executed from 1957 to 1960. The results of which were published in 1968 (LUDWIG 1968).

In trying to understand the geology of this basin the geology of the Austral Basin (also called Magellan basin or Tierra del Fuego basin) is immediately used as a reference. However the Malvinas basin is clearly separated from the Austral Basin by the Rio Grande Arch and consequently the stratigraphy should not be entirely similar. But not

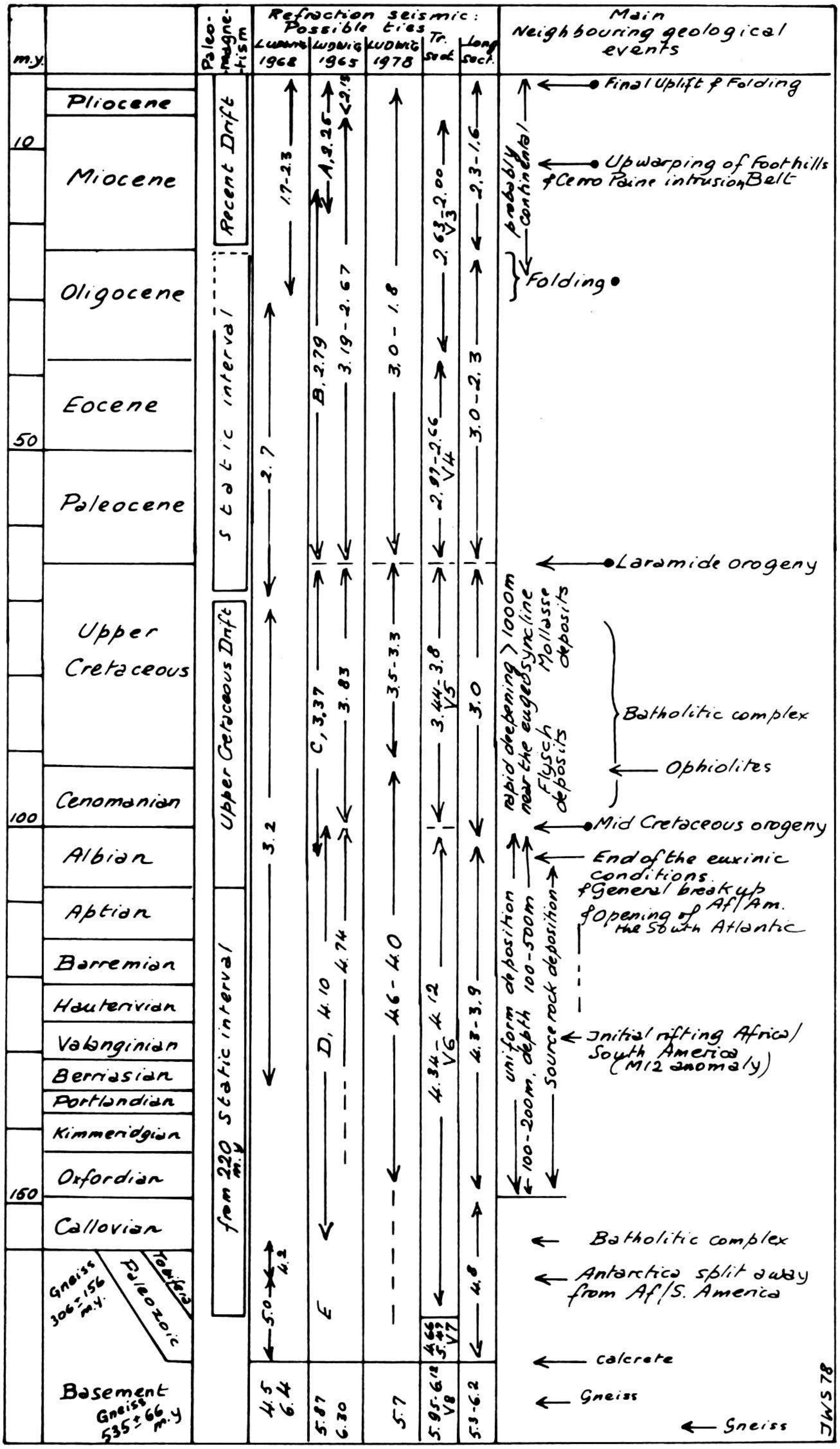

Fig. 12 Malvinas Basin
Possible geological column

having another nearer geological column at our disposition to forecast the stratigraphy of the Malvinas basin, one is bound to have recourse with great caution to the stratigraphy of the Austral basin.

The continental drift of South America (3620 km at Lat S 35°, (MAACK 1969, p. 144) helps us to outline the probable geological history of the Malvinas basin *(Fig. 12):* Prior to the end of Triassic times the South American continent, as a result of the Pan Africa orogeny, was linked to Africa as well as to Antarctica and also perhaps to some microplates (see *Fig. 5* in this respect). At the end of Triassic times the South American continent together with the African continent was separated from the Antarctic continent, a spreading ridge having come into existence between these two continents. Accordingly as shown on *Fig. 3 and 8* the Malvinas edge of South American continent (edge running presently east-West from the eastern end of the Falkland submarine Plateau to Tierra del Fuego), was facing at the beginning what might have been a graben and later on a gulf of a nascent Jurassic Indian Ocean. From time to time this sea was eventually connected with the Pacific through a narrow strait. During Jurassic and Cretaceous this sea was, according to its palaeolatitude, favourably located within the probable organic rich antarctic latitudinal zone of convergence, thereby allowing the sedimentation of souce rock.

From the results of Deep Sea Drilling (Leg 36) we know that at site 330 a source rock sequence was penetrated from 200 to 425 meters depth. This sequence is of the same age as the producing formation of the Austral Basin. We have already seen that this Upper Jurassic-Lower Cretaceous sea must have been present all along the Malvinas edge (as defined above) of proto-South America. These conditions prevailed through Valanginian times (127 (±2) m.y. ago). At that time a forerunner of the present Middle Atlantic spreading ridge came into existence between Africa and South America. The deposition of source rock came to an end during Albian times when the South American continent drifted rapidly westwards towards the Pacific. This displacement caused the Mid Cretaceous orogeny in the Austral basin, on the western edge of the drifting South American continent. This well marked orogeny, in the Austral basin, is not necessarily also developped in the West Malvinas basin, where it is most probably indicated by an important transgression at the base of the Upper Cretaceous, a transgression also marked by an important unconformity in the foothills belt.

Drifting westwards along the Falkland-Agulhas Transform Fault the South American continent was scraping the Patagonian eugeosyncline material, creating thus the Andean or Chilean mesozoic accretionary belt, but along the Malvinas edge of the continent the mechanical effect might have been quite different, and perhaps only dependent on subcrustal currents due to the horizontal thermic gradients. Consequently the Flysch and Mollasse deposits, characterizing the Upper Cretaceous of the Austral Basin, may not be developped in the Malvinas Basin.

For these reasons the use of the formation names and new stages recognized in the Austral Basin should be avoided. However as it is a temporary necessity to tie the refraction seismic results to the stratigraphic column known onshore, one is bound to follow, for the time being, the lead indicated by LUDWIG *(Fig. 12).*

On our tentative tectonic map of the West Malvinas Basin, *(Fig. 11),* the area of maximum thickness of sediments coincides with the Foothills Belt (outcropping in Tierra del Fuego). Also it can be seen that the Bahia Grande Arch clearly separates the Austral Basin from the West Malvinas Basin. The former appears as a foredeep to an orogen whereas the second one is on the contrary an intracratonic basin largely open towards the sea since early Mesozoic and deepening towards the Malvinas Through.

The thickness of the sediments in the south-eastern part of the West Malvinas Basin attains 7000 meters, this column of sediments is sufficient to permit source rocks to reach the proper hydrocarbon generating temperature and migration updip towards the W. Malvinas Basin. The oil generating formation is probably Oxfordian to Lower Albian in age. The reservoirs are probably sandstones derived from the erosion of the Falkland Uplift and from the Bahia Grande Arch. The excellently sorted sandstones of the eroded Silurian and Devonian sections have probably provided a first class material for Mesozoic sandy reservoirs and the erosion of Triassic rhyolitic lavas must also have provided a reservoir material although less adequate than the reworked Middle Paleozoic sandstones.

The sedimentary prism comprised between the eastern flank of the Bahia Grande Arch, the north-eastern prolongation of the Boqueron lineament, the Meredith lineament and the lineament indicated by a gravity bend (Gravbend) will probably be the first area to be probed for hydrocarbon deposits. Similarly, the Meredith lineament and the Stanley lineament respectively on the SW side and SE side of the Falkland Uplift will provide intriguing oil geological conditions.

Maps

Geologic Map of South America, (1950) 1:5000 00, 2 sheets. Published by the Geol. Soc. of America.

Mapa Geologico de la Republica Argentina, (1964) 3 sheets, 1:250000. Direccion nacional de Geologia y Mineria, Buenos-Aires.

Atlantic Ocean Floor, (1968) 1:30412800. Produced by the National Geographic Society for the Nat. Geogr. Magazine Washington D.C.

Geologic Map of Antarctica, (1971) scale 1:5000000 prepared by The Am. Geographical Society.

Magnetic lineations of the oceans, (1974) Map, compiled by W.C. Pittmann et al. printed by the Geol. Soc. of America, Inc., Boulder Colorado.

DINGLE, R.V. + SIESSER, W.G. (1977): Geology of the Continental Margin between Walvis Bay and Ponta do Ouro – *Map. Rep. of S. Africa,* Dept of Mines, Geol. Survey.

LA BRECQUE, J. and RABINOWITZ, P.D. (1977): Argentine Continental Margin, *Magnetic Anomalies Map,* Mercator projection. Published by the Am. Assoc. of Petr. Geologists, Tulsa.

RABINOWITZ, P.D. (1977): Argentine Continental Margin, *Free Air Gravity Anomalies Map.* Published by the Am. Assoc. of Petr. Geologists, Tulsa.

LUDWIG, W.J. et al. (1978): Argentine Continental Margin, *Sediment Isopach Map.* Published by American Assoc. of Petr. Geologists, Tulsa.

RABINOWITZ, P.D. (1978): Argentine Continental Margin, *Bathymetry Map.* Published by the Am. Assoc. of Petr. Geologists, Tulsa.

Texts

BARKER, P.F. and DALZIEL, I.W.D. (1976): Initial Reports of the Deep Sea Drilling Project. – Vol. 36, (U.S. Government Printing Office), Washington D.C., 1080 p.

BARRETT, D.M. (1977): Agulhas Plateau off Southern Africa: a geophysical Study. – Bull. Geol. Soc. of America 88/6, pp. 749 - 763.

BERGH, H.W., NORTON, I.O. (1976): Prince Edward Fracture Zone and the Evolution of the Mozambique Basin. – Journ. of Geophys. Res., Vol. 81, pp. 5221/5239.

BEURLEN, K. (1970): Geologie von Brasilien. – Gebrüder Borntraeger, Berlin, 444 p.

BORRELLO, A.V. (1972): Islas Malvinas. – In Geologia regional Argentina, Academia Nacional de Ciencias, Cordoba, pp. 755/770.

BRIDEN, J.C. (1967): Intercontinental Correlations based on Paleomagnetic evidence for recurrent continental Drift. – Gondwana Stratigraphie, Unesco, Buenos-Aires, pp. 421 - 435.
CAMINOS, R. (1972): Antarctida argentina, in Geologia regional Argentina, Academia nacional de Ciencias, Cordoba, pp. 771/796.
CHAMOT, G.A. (1961): Stratigraphy and Structure of the Foothills Belt adjacent to („Bogoc's Zone II"). – Unpublished Report - Bogoc - (YPFB) Santa Cruz, Bolivia.
DALZIEL, W.D. and ELLIOT, D.H. (1973): The Scotia Arc and Antarctic Margin. In „Oceans Basins and Margins". – Plenum Press, New York, pp. 171/246.
DALZIEL, I.W.D. et al. (1974): South Extremity of Andes: Geologia of Isla de los Estados, Argentine Tierra del Fuego. – Bull. A.A.P.G., vol. 58/12, pp. 2502 - 2512.
DALZIEL, I.W.D. (1974): Evolution of the margins of the Scotia Sea. – In Geology oft the Continental Margins, New York, Springer Verlag, pp. 567 - 579.
DALZIEL, I.W.D., DOTT, R.H., WINN, R.D., BRUHN, R.L. (1975): Tectonic relations of South Georgia Island to the Southernmost Andes. – Bull. Geol. Soc. America, Vol. 76/7, pp. 1034 - 1040.
DE WIT, M.J. (1977): The evolution of the Scotia Arc as a key to the reconstruction of Southwestern Gondwanaland. – Tectonophysics Vol. 37, pp. 53 - 81.
DIETZ, R., HOLDEN, J. (1970): Reconstruction of Pangea: breakup and dispersion of continents, Permian to present. – Journ. Geophys. Res. Vol. 75, No. 26, pp. 4939/4956.
DIETZ, R.S. (1973): Morphologic Fits of North America/Africa and Gondwana: A Review. – In „Implications of Continental Drift", Academic Press, pp. 865/871.
DINGLE, R.V. and KLINGLER, H.C. (1971): Significance of Upper Jurassic sediments in the Knysna Outlier (Cape Province) for timing of the breakup of Gondwana. – Nature, Vol. 232, pp. 37 - 38.
DINGLE, R.V. and SCRUTTON, R.A. (1974): Continental break up and the development of post Paleozoic sedimentary Basins around southern Africa. – Bull. Geol. Soc. Am. Vol. 85, pp. 1467 - 1474.
DSDP Leg. 36. See under Barker.
DUTOIT, A.L. (1937): Our Wandering continents. – Edingburgh, Oliver and Boyd, 366 p.
EWING, J., LUDWIG, W.J., EWING, M. and EITTREIM, S.L. (1971): Structure of the Scotia Sea and Falkland Plateau. – Journ. Geophys. Research, V. 16, pp. 7118 - 7137.
FAVRE, F. (1908): Description d'une faune d'Ammonites du Cretacique inférieur de Patagonie. – Archives des Sciences, Genève, Vol. 27, p. 167 - 190.
FLORES, G. (1970): Suggested Origin of the Moçambique Channel, Tans. Geol. Soc. S. Africa, 73 pp. 1 - 16.
FORSYTH, D.W. (1975): Fault plane solutions and tectonics of the South Atlantic and Scotia Sea. – Journ. of Geophys. Research, V. 80, p. 1429 - 1443.
FRANCHETEAU, J. and LEPICHON, X. (1972): Marginal fractures as Structural Framework of Continental Margins in South Atlantic Ocean. – Bull. A.A.P.G. 56/6, pp. 991 - 1007.
HAMILTON W. (1973): Tectonics of Antarctica, in „Backbone of the Americas". – Mem. No. 2, Am. Assoc. of Petr. Geologists.
– (1964): Antarctica and Pacific Tectonics – XXII Int. Geol. Congress New Delhi, pp. 443 - 459.
HOUTZ, R.E. (1977): Sound velocity characteristics of sediment from the South American margin. – Bull. Geol. Soc. of America, Vol. 88/5, pp. 720 - 722.
– (1974): Continental Margin of Antarctica Pacific Indian Sectors, in „The Geology of Continental Margins". C.A. Burk & C.L. Drake editors, Springer Verlag, pp. 655 - 658.
KATZ, H.R. (1964): Some new concepts on geosynclinal developments and mountain building at the Southern end of South America. – 22nd Int. Geol. Congress, New Delhi, Proc., vol. 4, pp. 241 - 255.
– (1972): Plate Tectonics and orogenic Belts in the South-East Pacific. – Nature, vol. 237, pp. 331 - 332.
KENT, P.E. (1973): East African Evidence of the Palaeoposition of Madagascar, in „Implications of Continental Drift". – Academic Press, London, pp. 873 - 875.
KING, L.C. (1973): An improved reconstruction of Gondwanaland, in „Implications of Continental Drift". – Academic Press, London, pp. 851 - 863.
KING, L. (1980): Gondwana reunited. – Geology, Vol. 8/2, pp. 111 - 112.
LADD, J.W. et al. (1973): The Age of the South Atlantic, in „The Oceans Basins and Margins". – Plenum Press, New York, pp. 555 - 573.
LARSON, R.L. and LADD, J.W. (1973): Evidence for the opening of the South Atlantic in the Early Cretaceous. – Nature, Vol. 246, pp. 209 - 212.
LEG 36 – See Barker P.F.

LEHNER, P. and DE RUITER, P.A.D. (1976): Africa's margin typified by string of basins. – O.G.J. Nov. 8, 1976.
LOCK, B.E. (1980): Flat plate subduction and the Cape Fold Belt of South Africa. – Geology, Vol. 8, No. 1, pp. 35 - 39.
LUDWIG, W.J., EWING, J.I. and EWING, M. (1965): Seismic refraction measurements in the Magellan straits. – Journ. Geophys. Res., Vol. 70, pp. 1855 - 1876.
– (1968): Structure of Argentine Continental Margin. – Bull. A.A.P.G., vol. 52/12, pp. 2337 - 2368.
LUDWIG, W.J., et al. (1978): Structure of Falkland Plateau and offshore Tierra del Fuego, Argentina, in Geophysical Investigations of Continental Slopes and Rises. A.A.P.G. publication in press.
MAACK, R. (1963): Kontinentaldrift und Geologie des Südatlantischen Ozeans. – Walter de Gruyter & Co., Berlin, Publishers.
NAIRN, A.E.M. (1973): The argument for a Southern Uratlantic, in „Implications of Continental Drift". – Academic Press, London, pp. 799 - 804.
NAIRN, A.E.M. and STEHLE, F.G. (1973): A Model for the South Atlantic, in „Oceans Basins and Margins". – Plenum Press, New York, pp. 1 - 24.
NATLAND, M.L. et al. (1974): A System of Stages for Correlation of Magallanes Basin sediments. – Mem. Geol. Soc. America No. 139.
OLEA, R.A., DAVIS, J.C. (1977): Regionalized Variables for Evaluation of Petroleum Accumulation in Magellan Basin, South America. – Bull. A.A.P.G. 61/4, pp. 588 - 572.
PIPER, J.D.A. (1973): Geological Interpretation of Palaeomagnetic Results from the African Precambian, in „Implications of Continental Drift to the Earth Sciences". Academic Press, London, pp. 19 - 31.
RABINOWITZ, P.D. (1976): Geophysical Study of the Continental margin of Southern Africa. – Bull. Geol. Soc. of America, Vol. 87/11, pp. 1643 - 1653.
REYMENT, R.A. (1973): Cretaceous History of the South Atlantic Ocean, in „Implications of Continental Drift". – Academic Press, London, pp. 805 - 814.
SCHROEDER, J.W. (1946): Geologie de l'île de Larak Contribution à l'étude des dômes de sel du golfe Persique. Comparaison avec la Salt Range. – Arch. Sc. Phys. et Nat. 1946, Janv. - Févr., pp. 5 - 18.
SCIENTIFIC STAFF (1974): DSDP, Southwestern Atlantic Leg 36. – Geotimes, Nov. 1974, pp. 16 - 18.
SCOTT, K.M. (1966): Sedimentology and dispersal pattern of a Cretaceous Flysch sequence, Patagonian Andes, Southern Chile. – Bull. A.A.P.G., 50/1, pp. 72 - 107.
SCRUTTON, R.A. and DU PLESSIS, A. (1973): Possible marginal fracture south of South Africa. – Nature, Vol. 242, pp. 180 - 182.
SIESSER, W.G., SCRUTTON, R.A., SIMPSON, E.S.W. (1974): Atlantic and Indian Ocean Margins of Southern Africa, in „The Geology of Continental Margins". – C.A. Burk + C.L. Drake editors, Springer Verlag, pp. 641 - 654.
SIGAL, J. et al. (1970): Sur l'âge et les affintés gondwaniennes de microfaunes malgaches, indiennes et chiliennes au sommet du Jurassique et à la base du Crétacé. – C.R. Acad. Sci., Vol. 271, ser. D, No. 1, pp. 24 - 27.
SUAREZ, M. (1976): Plate tectonic model for southern Antarctic Peninsula and its relation to southern Andes. – Geology, Vol. 4, pp. 211 - 214.
TARLING, D.H. (1973): The palaeoposition of Madagascar Comment, in „Implications of Continental Drift to the Earth Sciences". – Academic Press London, pp. 876/7.
THOMAS, C.R. (1949): Geology and petroleum exploration in Magallanes province, Chile. – Bull. A.A.P.G. Vol. 33, pp. 1553 - 1578.
URIEN, C.M. and ZAMBRANO, J.J. (1973): The Geology of the basins of the Argentina Continental margin and Malvinas plateau, in „The Ocean Basins and Margins". – A.E.M. Nairn + F.G. Stehi, Plenum Press, New York, pp. 135 - 170.
WHITEMAN, A.J. (1965): A summary of present Knowledge of the Rift valley and associated Structures in Sudan. – Report on the Upper Mantle Committee and Unesco Seminar on the East African Rift System, Nairobi, pp. 34 - 45.
ZAMBRANO, J.J., URIEN, C.M. (1974): Pre Cretaceous Basins in the Argentine Continental Shelf, in „The Geology of Continental Margins". – C.A. Burk + C.L. Drake editors, Springer Verlag, pp. 463 - 470.
ZEIL, W. (1964): Geologie von Chile. – Gebrüder Borntraeger, Berlin, p. 233.