

Depositional History of the West Nile Delta - Upper Oligocene to Upper Pliocene*

Axel Kellner¹, Hamsa El Khawaga¹, Gerhard Brink², Stiig Brink-Larsen², Maksoud Hesham¹, Hesham Abu El Saad¹, Alaa Atef¹, Helen Young¹, and Bruce Finlayson²

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¹Exploration, RWE Dea, Cairo, Egypt (<mailto:axel.kellner@rwe.com>)

²Consultant, Cairo, Egypt

Abstract

Several Nile Delta publications in recent years have used very good quality data to illustrate and discuss depositional systems in great detail. The data presented in this study adds regional context to the common understanding.

Recently acquired 3D seismic surveys in the onshore, offshore and transition zone were interpreted as part of a Nile Delta Prospectivity Study. Well data from more than 40 years of hydrocarbon exploration were integrated. These data provided the basis for a regional understanding of the sedimentary and structural evolution during the past 30 million years.

A robust biostratigraphic zonation scheme was adopted and consistently implemented to more than 60 wells throughout the study area. Integration of seismic surfaces and facies analysis using a variety of seismic attribute extractions and sedimentary facies, calibrated by well data and stacking pattern analysis, were done on a sequence by sequence level. A seismic facies catalogue was generated for different depositional environments.

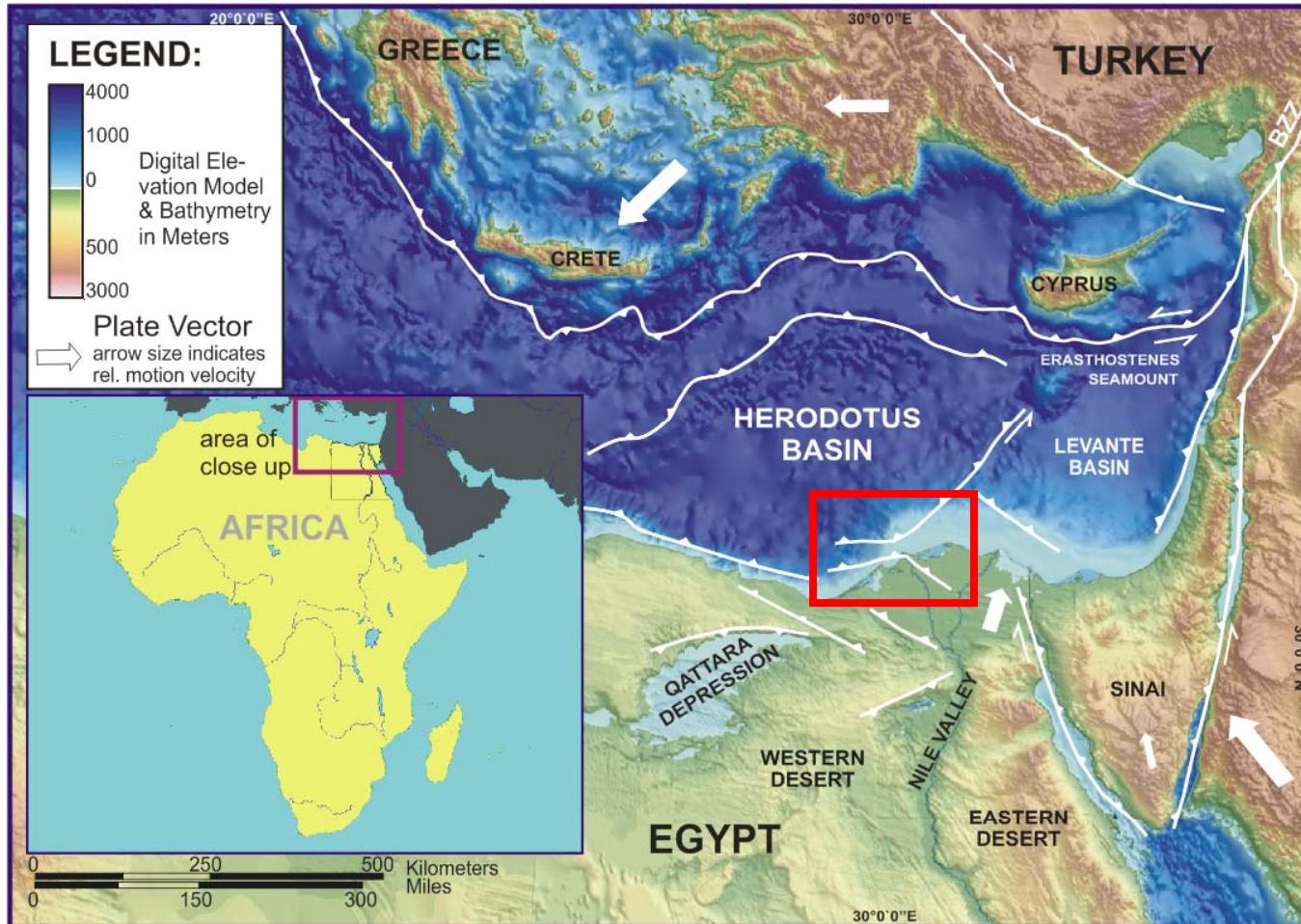
Paleo-depositional systems maps were constructed and serve as snapshots, mostly of lowstand systems, for each timeframe. These maps illustrate the regional depositional history for the West Nile Delta. They reflect, for instance, the relation between lowstand prograding deltas and relict shelf breaks at type one unconformities to the generally more distal and productive offshore slope settings. The different positions of the mapped relict shelfbreak and facies distribution in different sequences reflects the evolution of the deltaic geometry over the timeframe investigated as well as the sedimentary response to regional tectonic events at the time of

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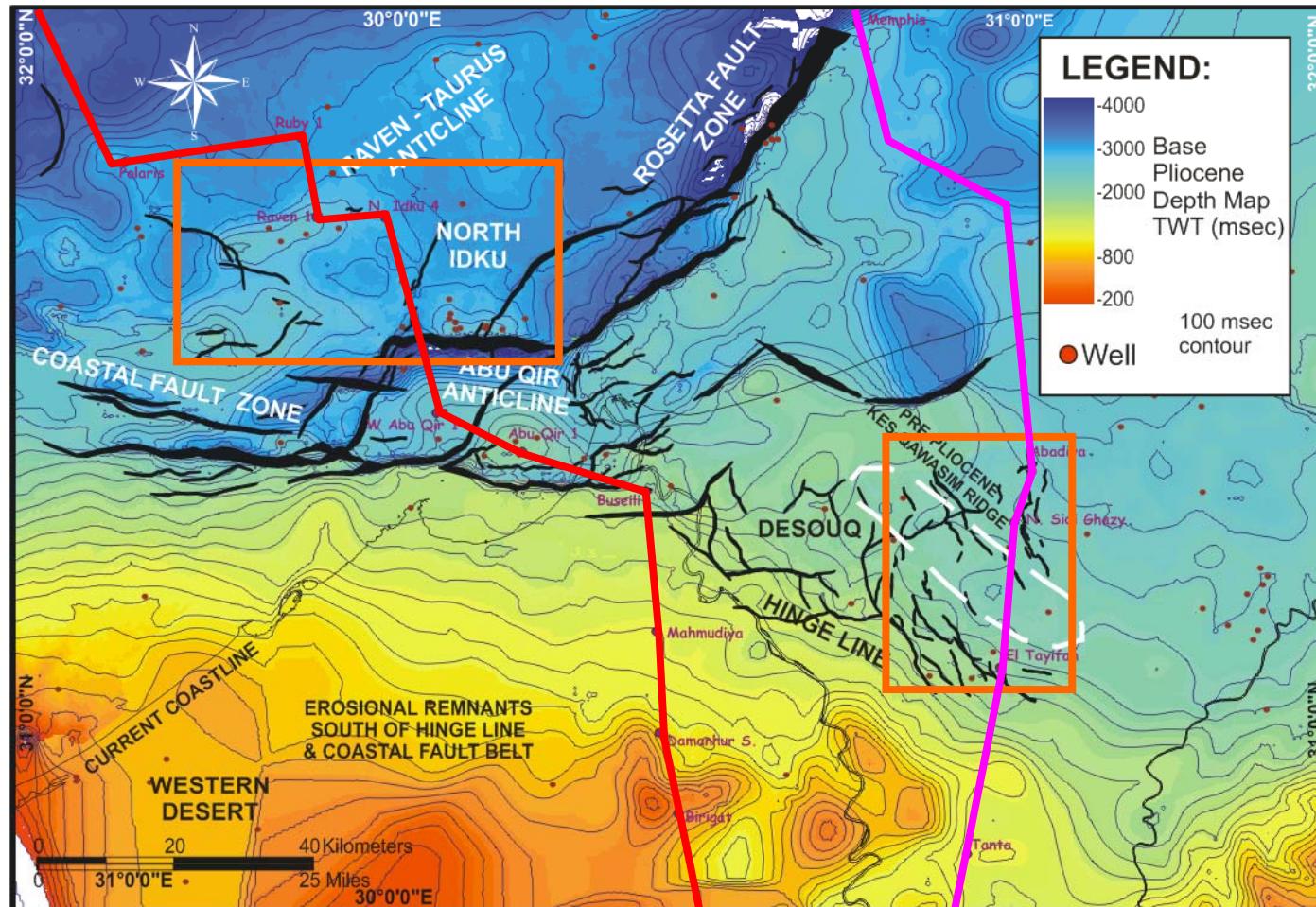


Location Map and current plate tectonic setting of the study area

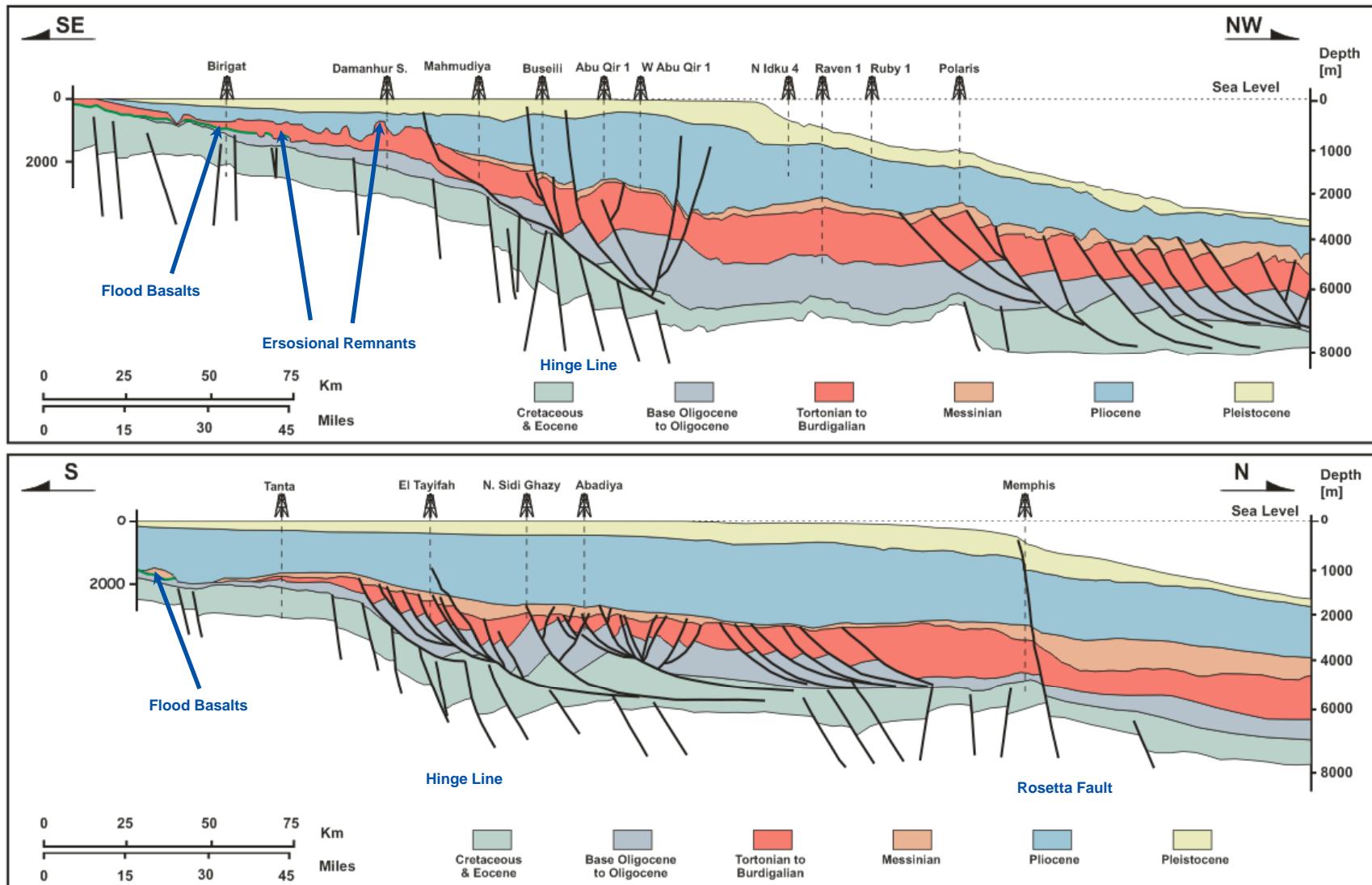


- > Bathymetry and DEM data after: IOC, IHO and BODC, 2003. Centenary Edition of the GEBCO Digital Atlas, published on CD-ROM on behalf of the Intergovernmental Oceanographic Commission and the International Hydrographic Organization as part of the General Bathymetric Chart of the Oceans, British Oceanographic Data Centre, Liverpool, U.K.

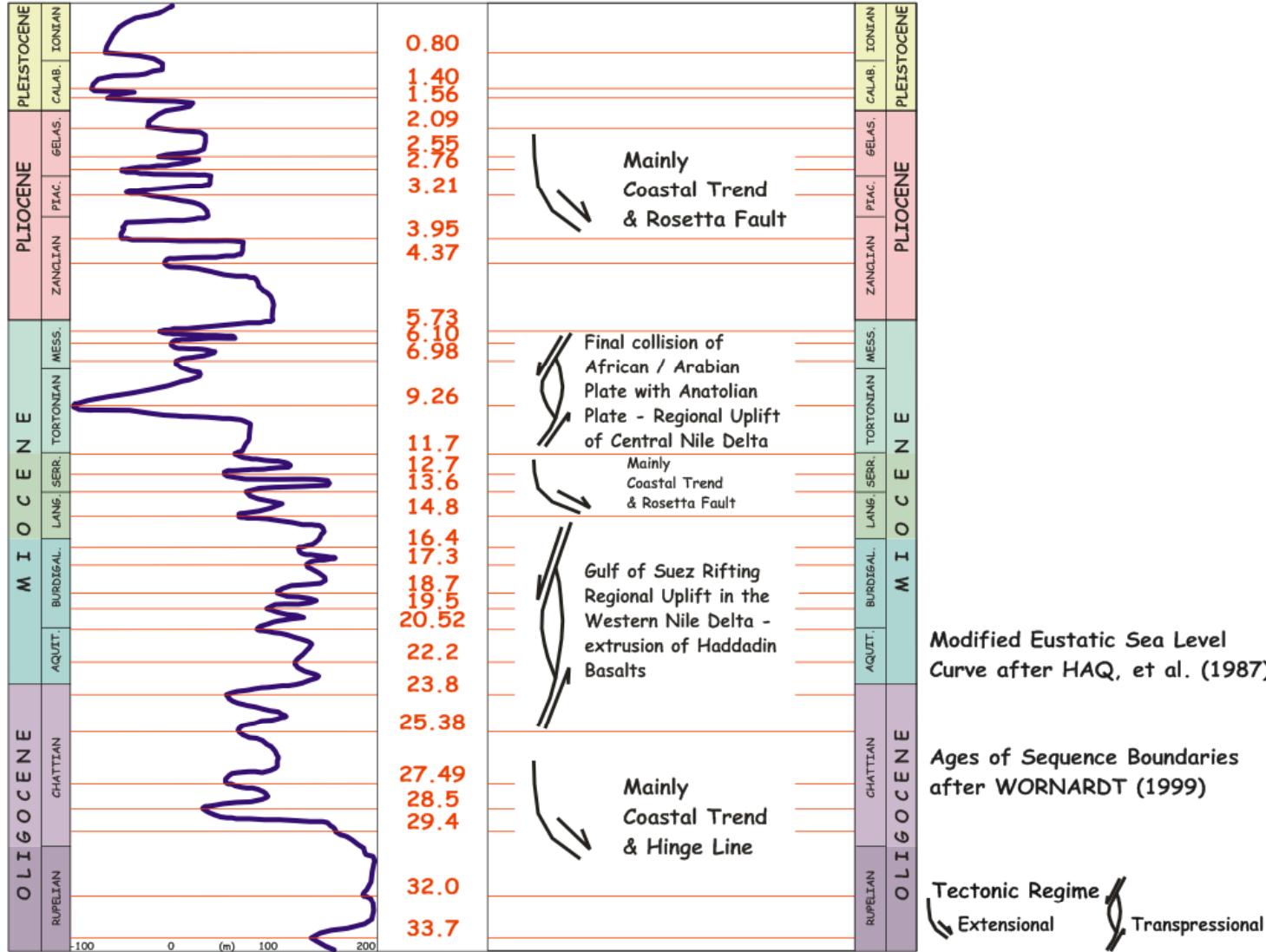
Base Pliocene Depth Map throughout the study area



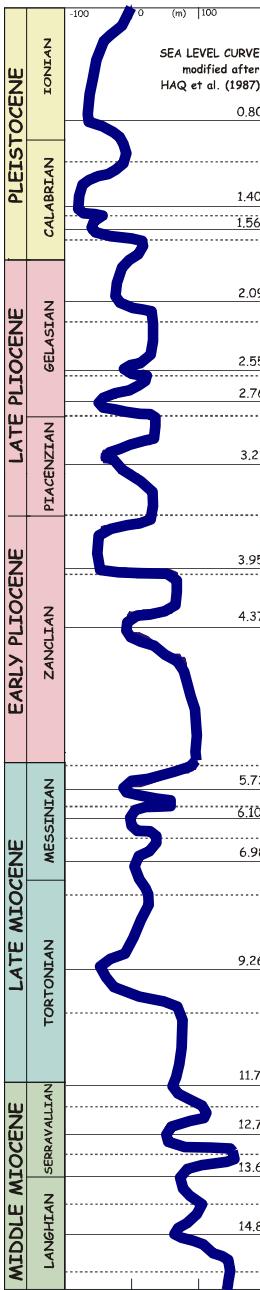
Regional Cross Sections within the study area



Timing of Tectonic Events and relative Sea Level Changes in WND

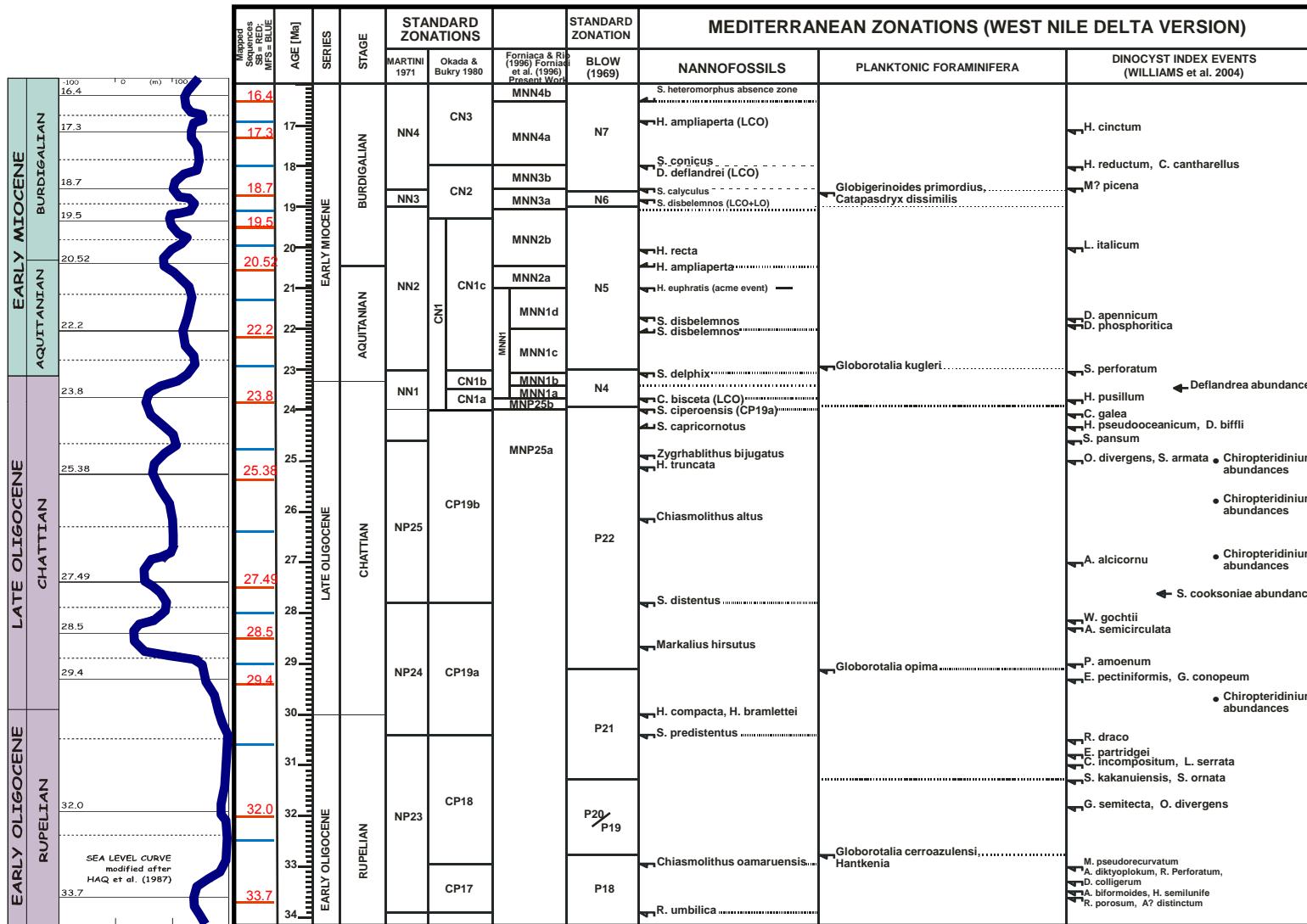


Biostratigraphical zonation scheme for the Eastern Mediterranean



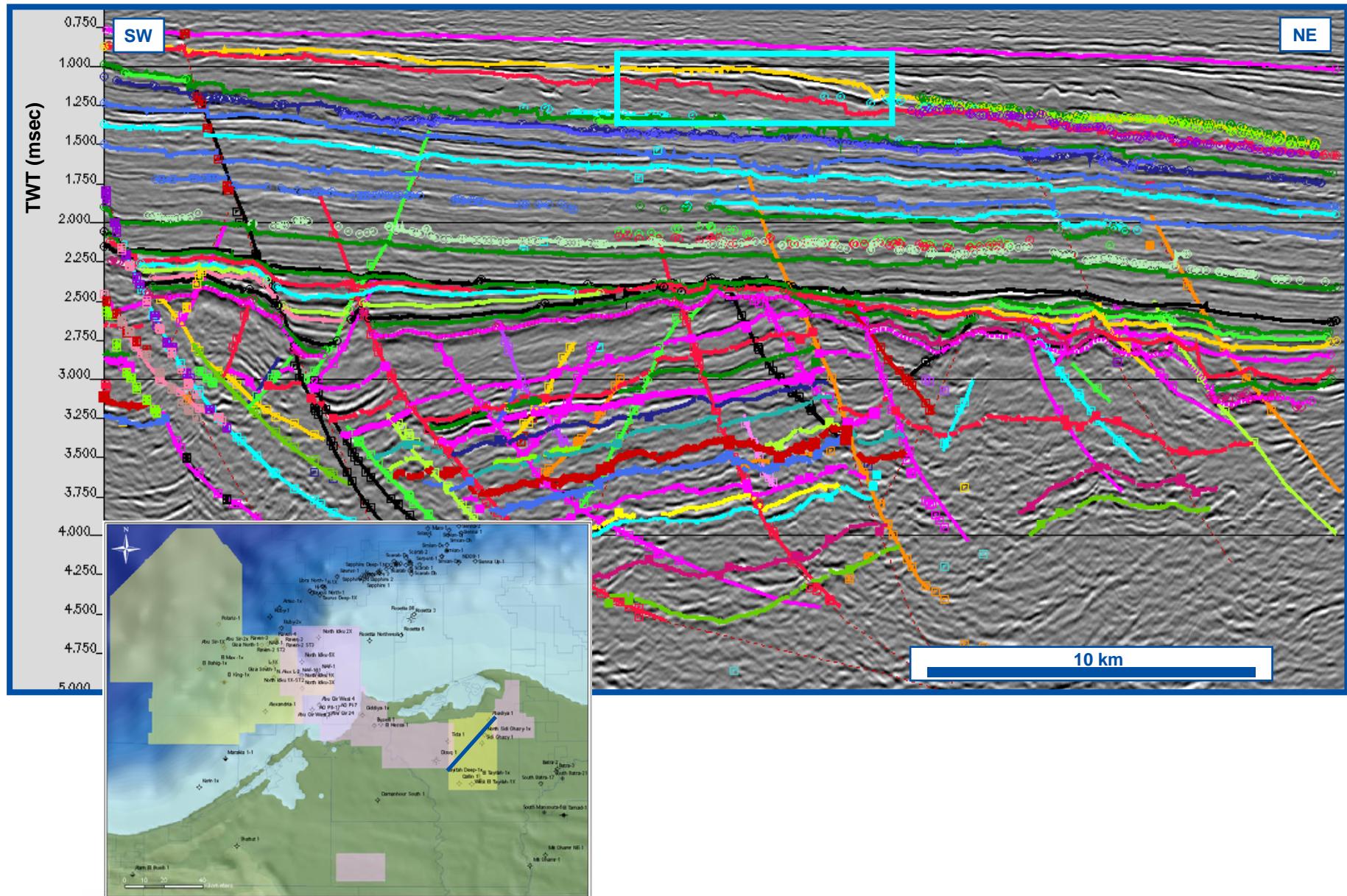
MARTINI 1971	Okada & Bukry 1980	STANDARD ZONATIONS		BLOW (1969)	MEDITERRANEAN ZONATIONS (WEST NILE DELTA VERSION)		
		AGE [Ma]	SERIES		NANNOFOSSILS	PLANKTONIC FORAMINIFERA	DINOCYST INDEX EVENTS (WILLIAMS et al. 2004)
		Forniaca & Röhl (1995); Forniaca et al. (1996); Present Work					
NN21	CN15	MNN21b			H. inversa Gephyrocapsa oceanica		
NN20	CN14b	MNN20			Pseudoemiliania lacunosa	Globorotalia truncatulinoides Globorotalia tosaensis Globorotalia ronda	
		MNN19f					
		CN14a					
NN19	CN13b	MNN19e			Acme Gephyrocapsa spp. <4 microns		
		MNN19d			H. sellii		
		MNN19c			C. macintyrei		
NN18	CN12d	MNN18			R. minutula / minuta	Globorotalia acostaensis (dextral) Globorotalia inflata acme	
NN17	CN12c	MNN17			D. brouweri	Globigerinoides extremus	S. dionaeacysta, T. glorianum
	CN12b	MNN16b					
NN16	CN12a	MNN16a			H. sellii acme	Globorotalia crassaformis acme Globorotalia miocenica	
NN15	CN11b	MNN15			D. pentaradiatus	Globorotalia bononiensis	
NN14	CN11a	MNN14			D. asymmetricus		A. umbracula, A. confusum, I. tabulata, S. drugii, C. harlandii, O ? eirikanum
NN13	CN10c	MNN13			D. tamalis		
NN12	CN10b	MNN12			D. variabilis	Globogaudrina altispira Sphaeroidinellopsis seminudina	E. sexispinosa
NN11	CN9b	MNN11c			S. abies R. pseudoumbilicus	Sphaeroidinella dehiscens immatura	
NN10	CN8b	MNN10b			D. asymmetricus increase	Globorotalia punctulata Globorotalia margaritae	
NN9	CN8a	MNN10a			S. verensis		
NN8	CN6	MNN9			A. tricornutulus	Globigerina nepenthes	
NN7	CN5b	MNN8b			Triquetrorhabdulus rugosus	Orbulina bilobata acme Ammonia beccarii acme	
NN6	CN5a	MNN8a			D. quinqueramus	Sphaeroidinellopsis spp. acme	
NN5	CN4	MNN7c**			D. torulus		R. actinocorona
NN4		MNN7b**			H. orientalis		B. evangelineae
NN3		MNN6b			H. rotaria		S. armageddonensis
NN2		MNN6a			H. stalis		G. etrusca
NN1		MNN5b			S. moriformis		H. floripes
NN0		MNN5a			H. waltrans	Globorotalia siakensis	H. tenuispinosum
					H. ampliaperta		M. robustum S. soucouyantiae
							P. striatogranolesum
							G. verricula
							N. downiei
							C. poulsenii, C. passio
							C. aubryae
							U. aquaeductum
							E. burdigalensis
							H. tenuispinosum
							P. fairhavenensis

Biostratigraphical zonation scheme for the Eastern Mediterranean

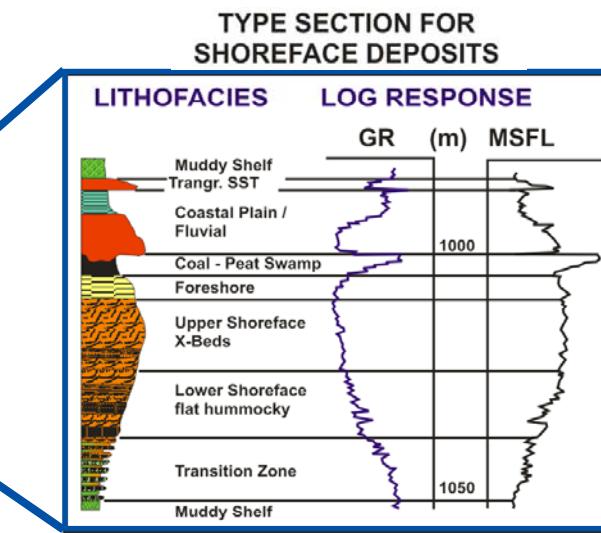
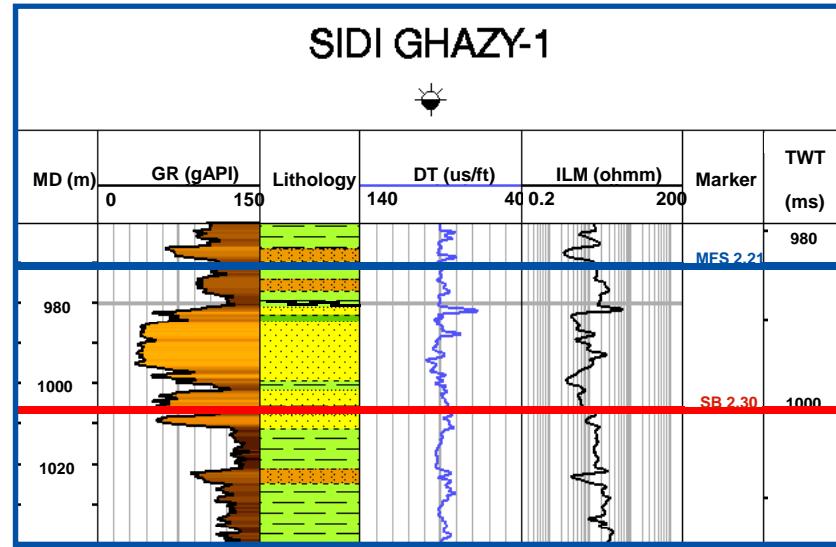
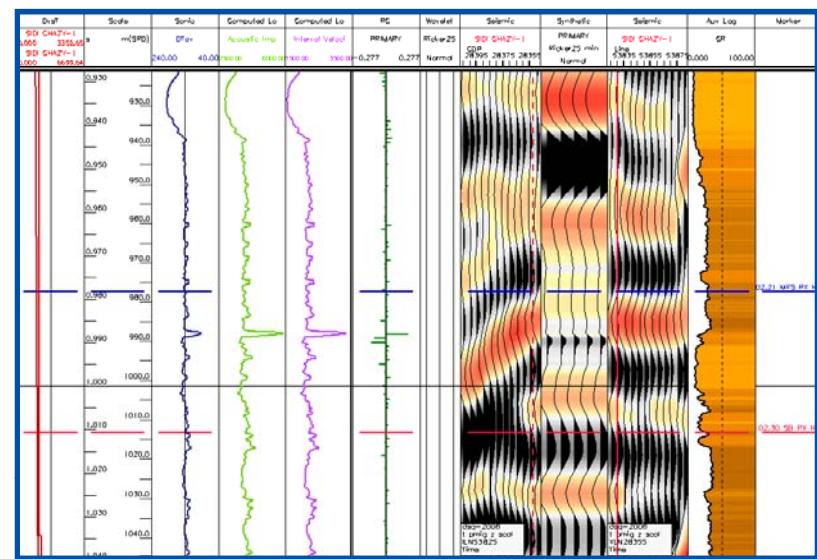
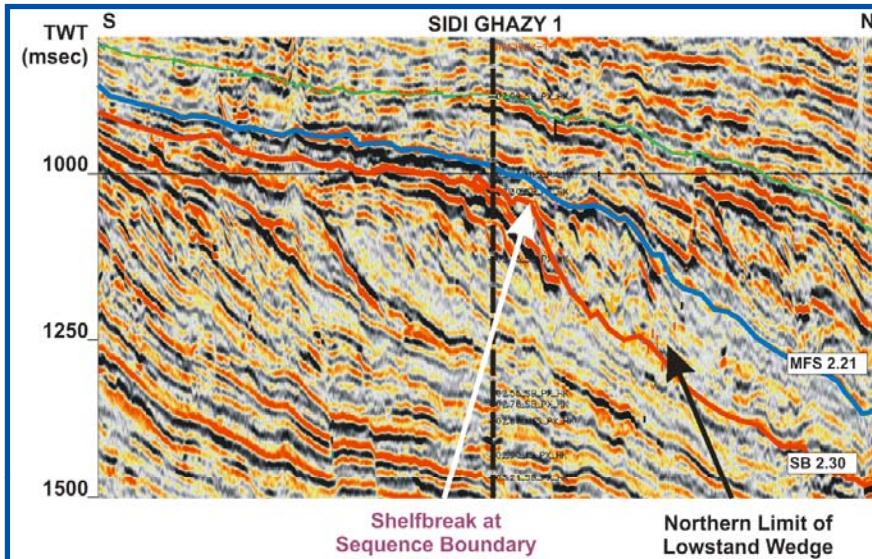


- > Age of major sequence stratigraphic units after WORNARDT (1999); RWE Dea inhouse work by JUTSON D., YOUNG H. & KELLNER A. (2006).

Seismic Cross Section as Example

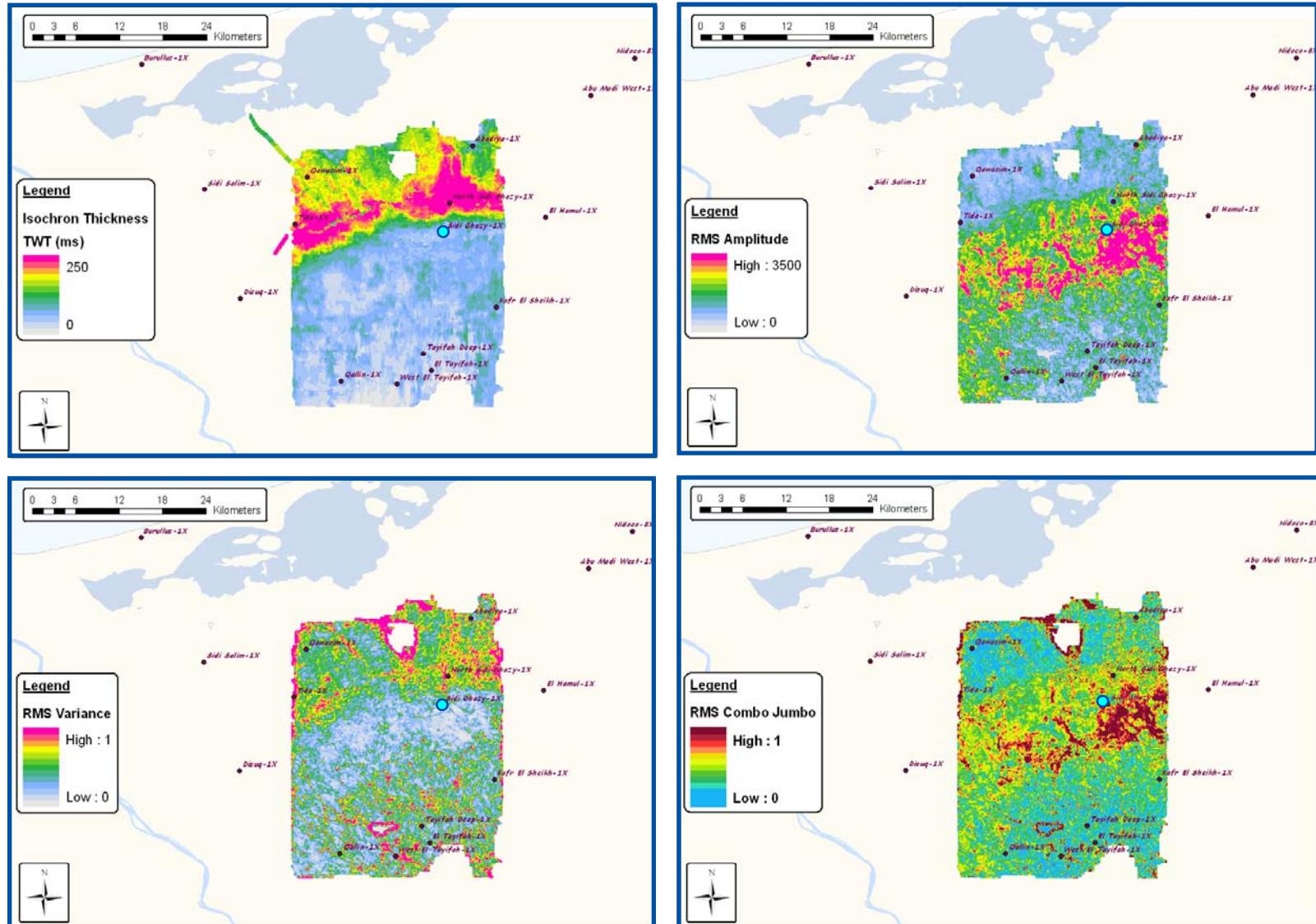


Facies Interpretation using Seismic & Borehole Data

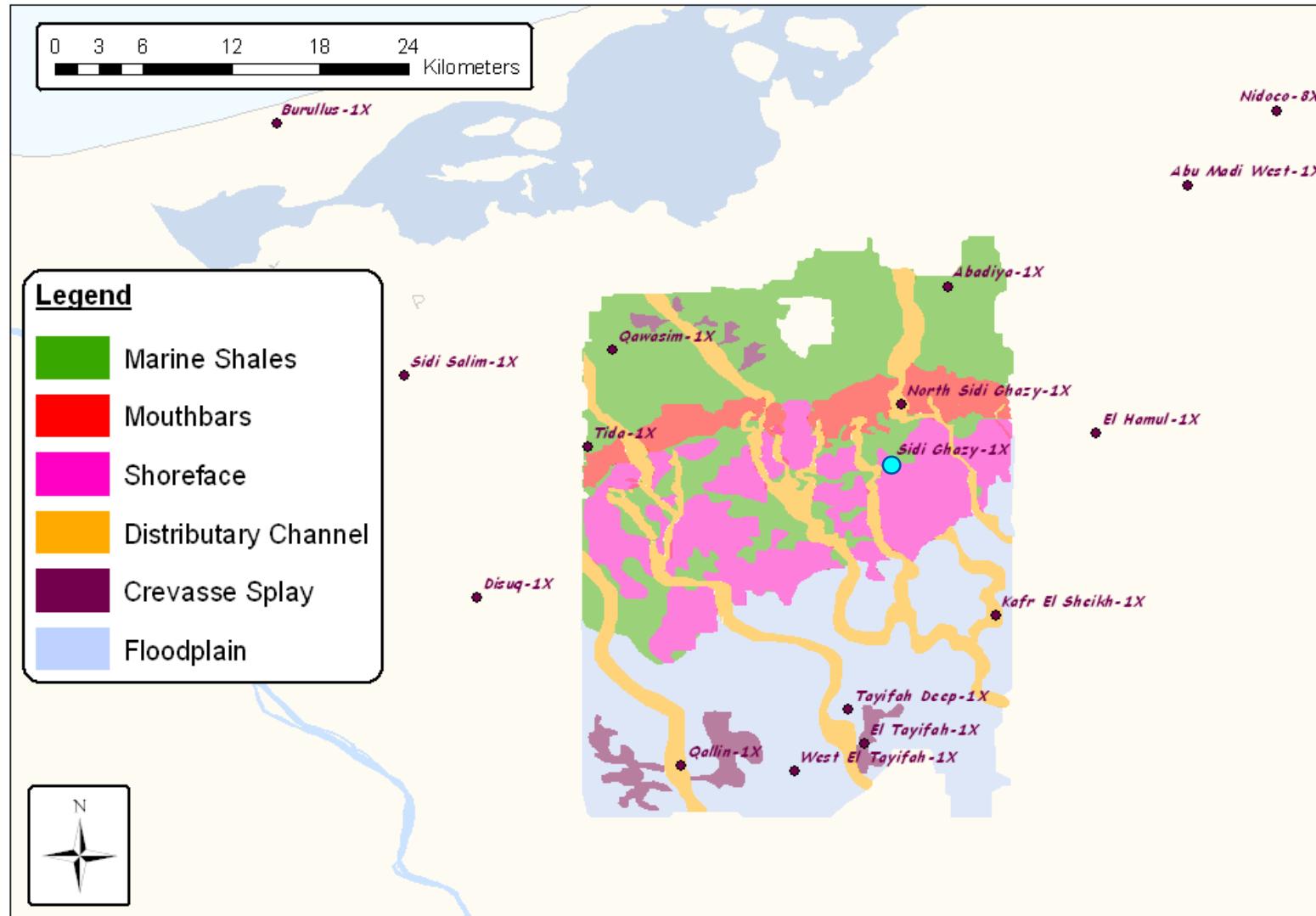


> Type log modified after KRYSTINIK (pers. comm. 2007) and BALSLEY & PARKER (1983).

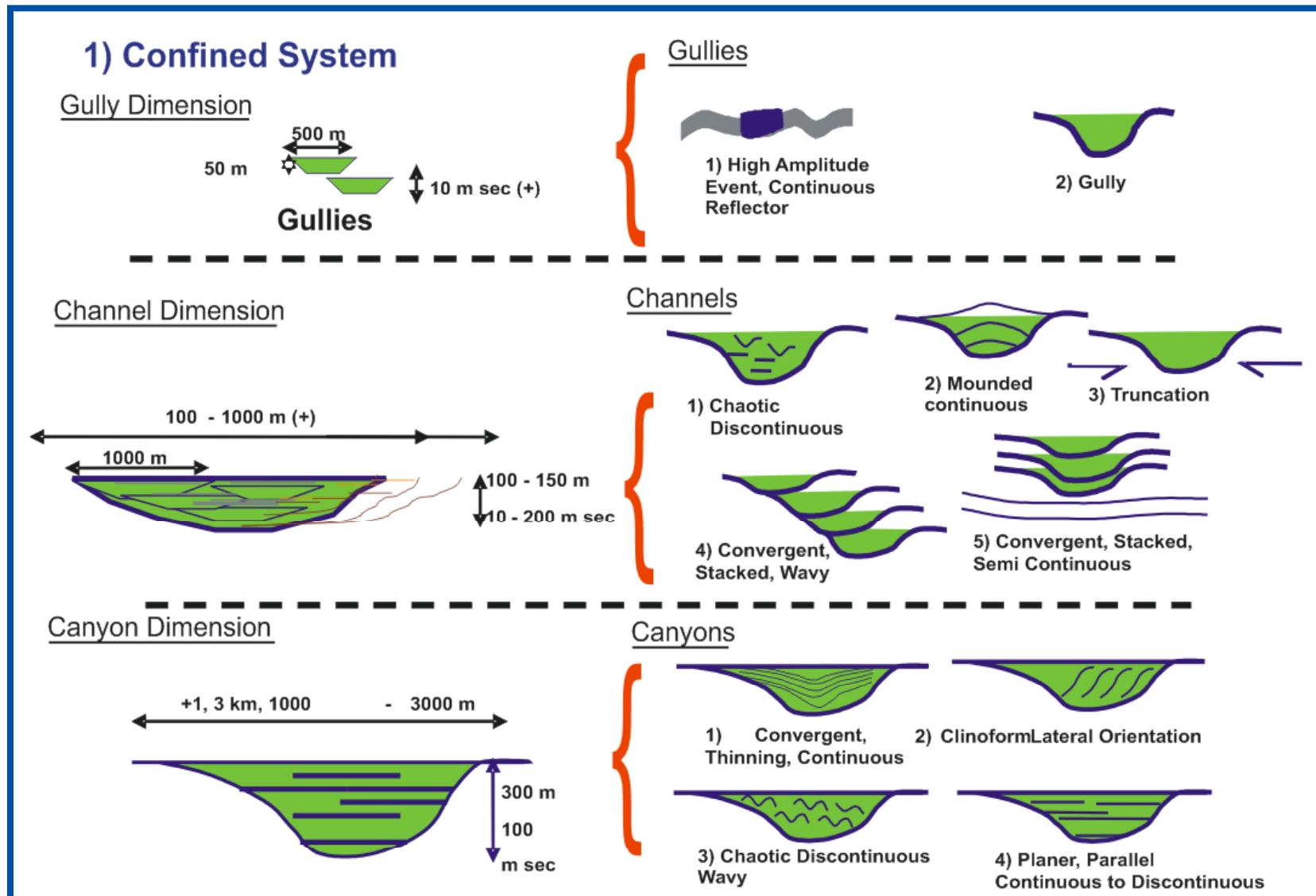
Thickness and Attribute Extraction of Correlative Intervals



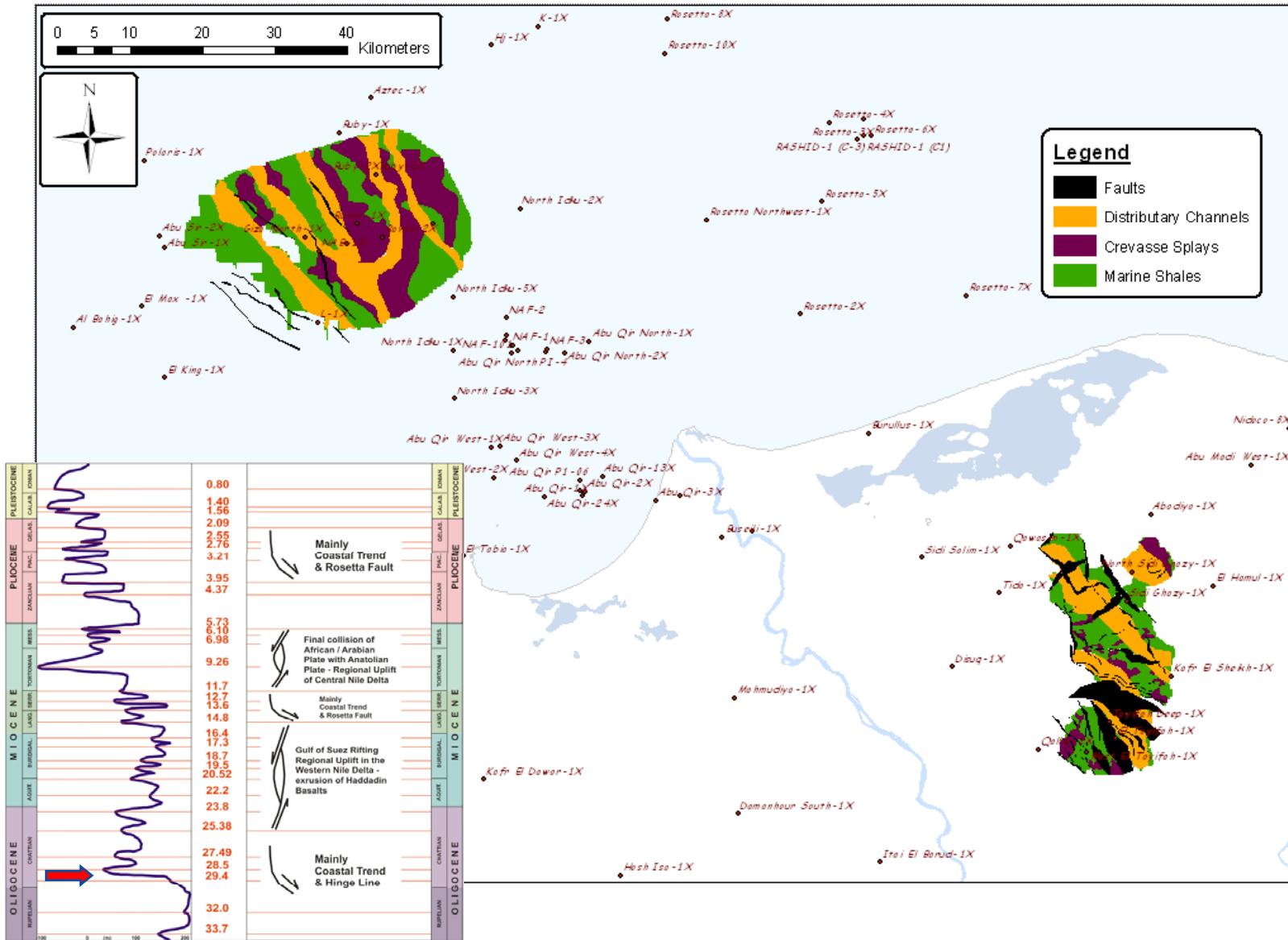
Facies Map for the Lowstand & Transgressive Depositional Systems



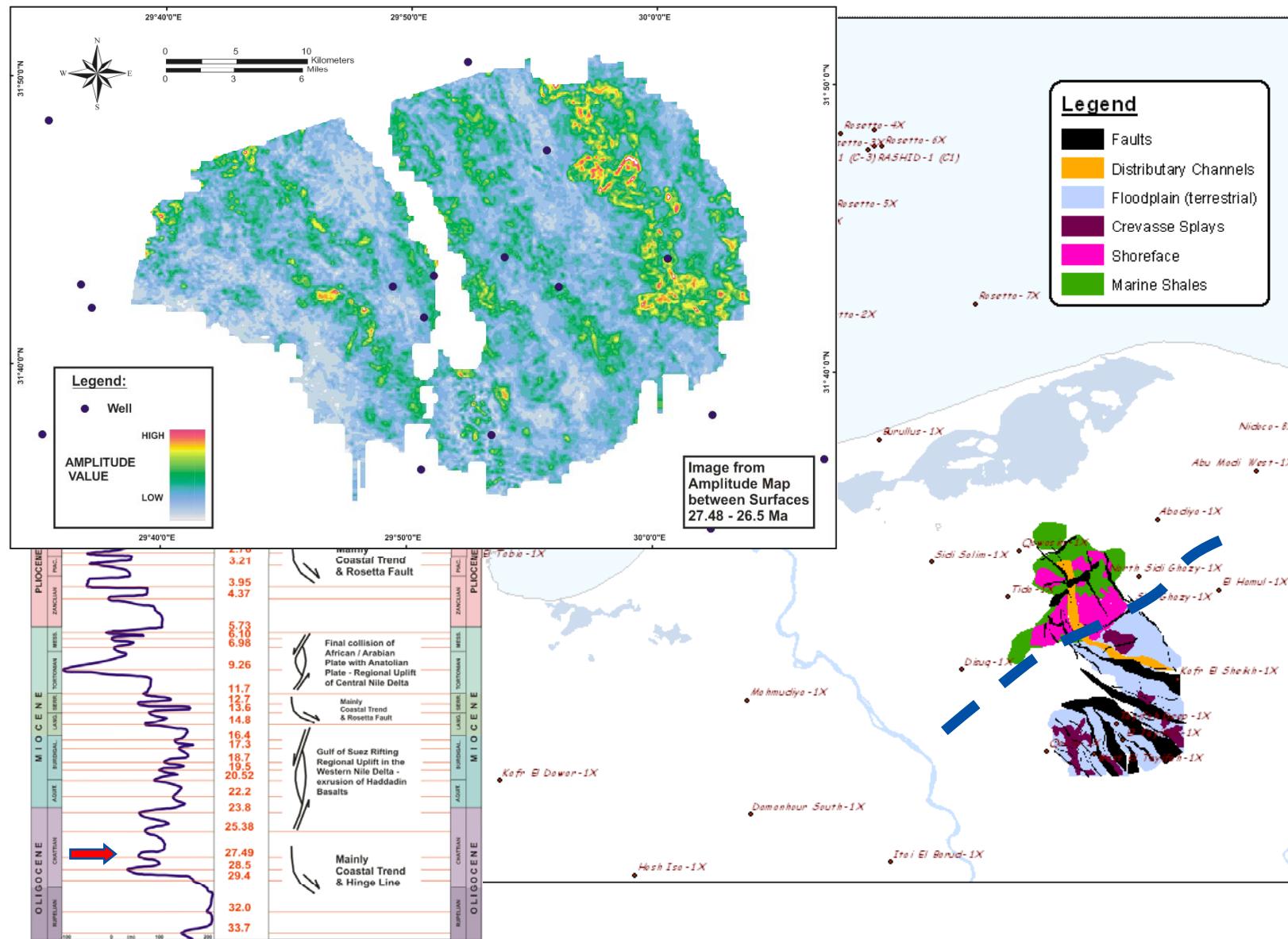
Seismic facies catalogue for depositional facies interpretation



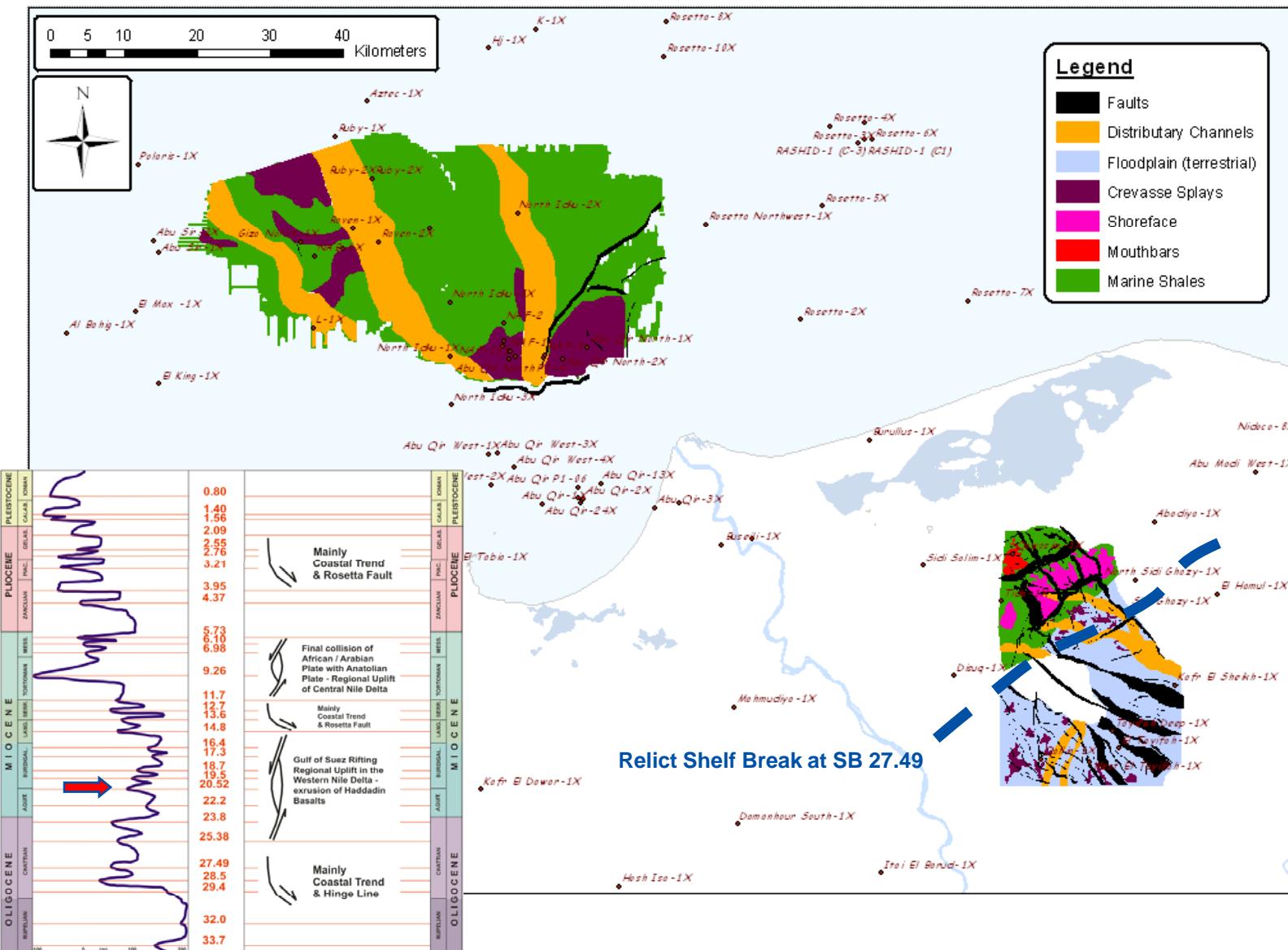
Gross Depositional Environment Map for SB 29.4



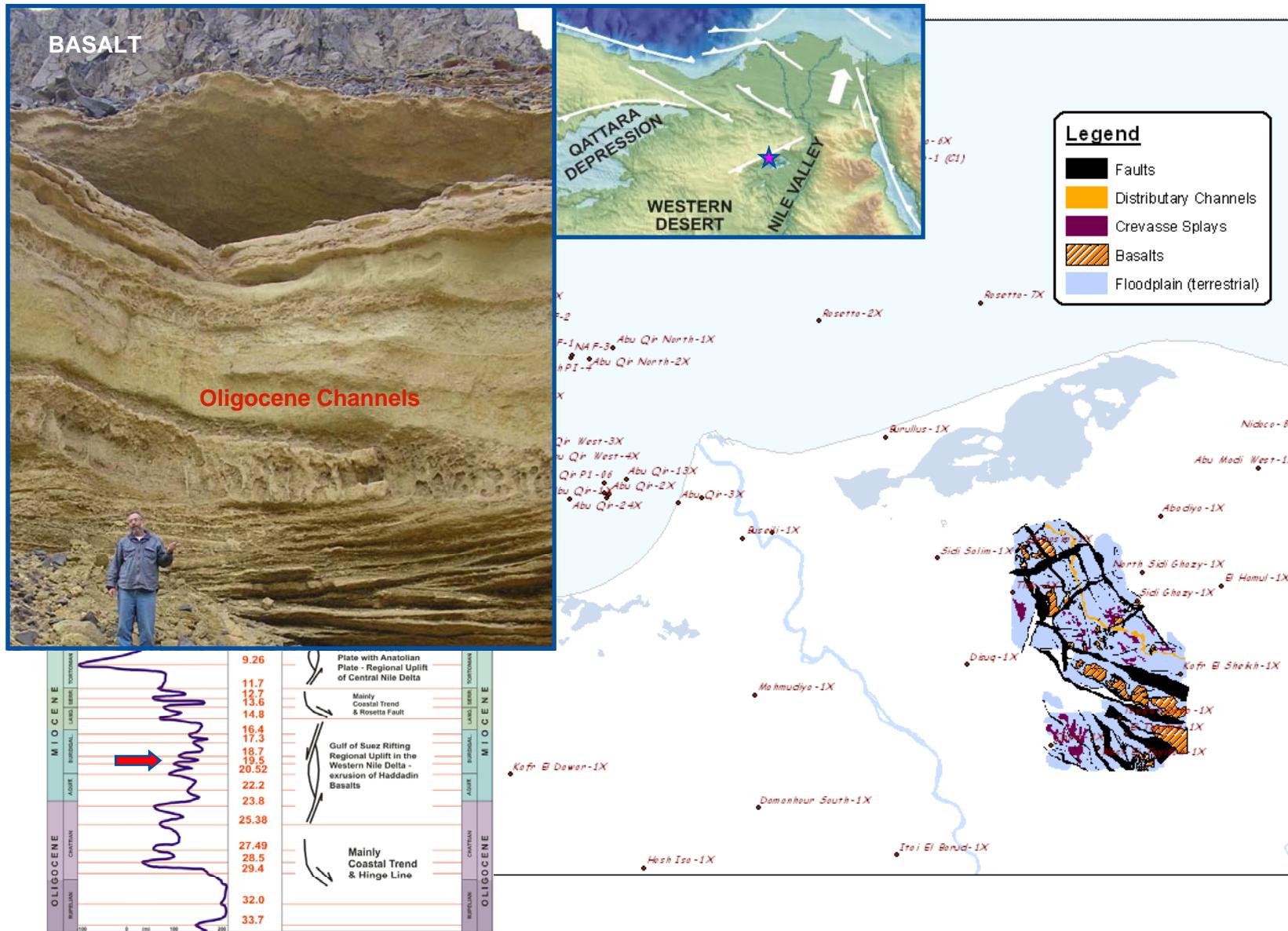
Gross Depositional Environment Map for SB 27.49



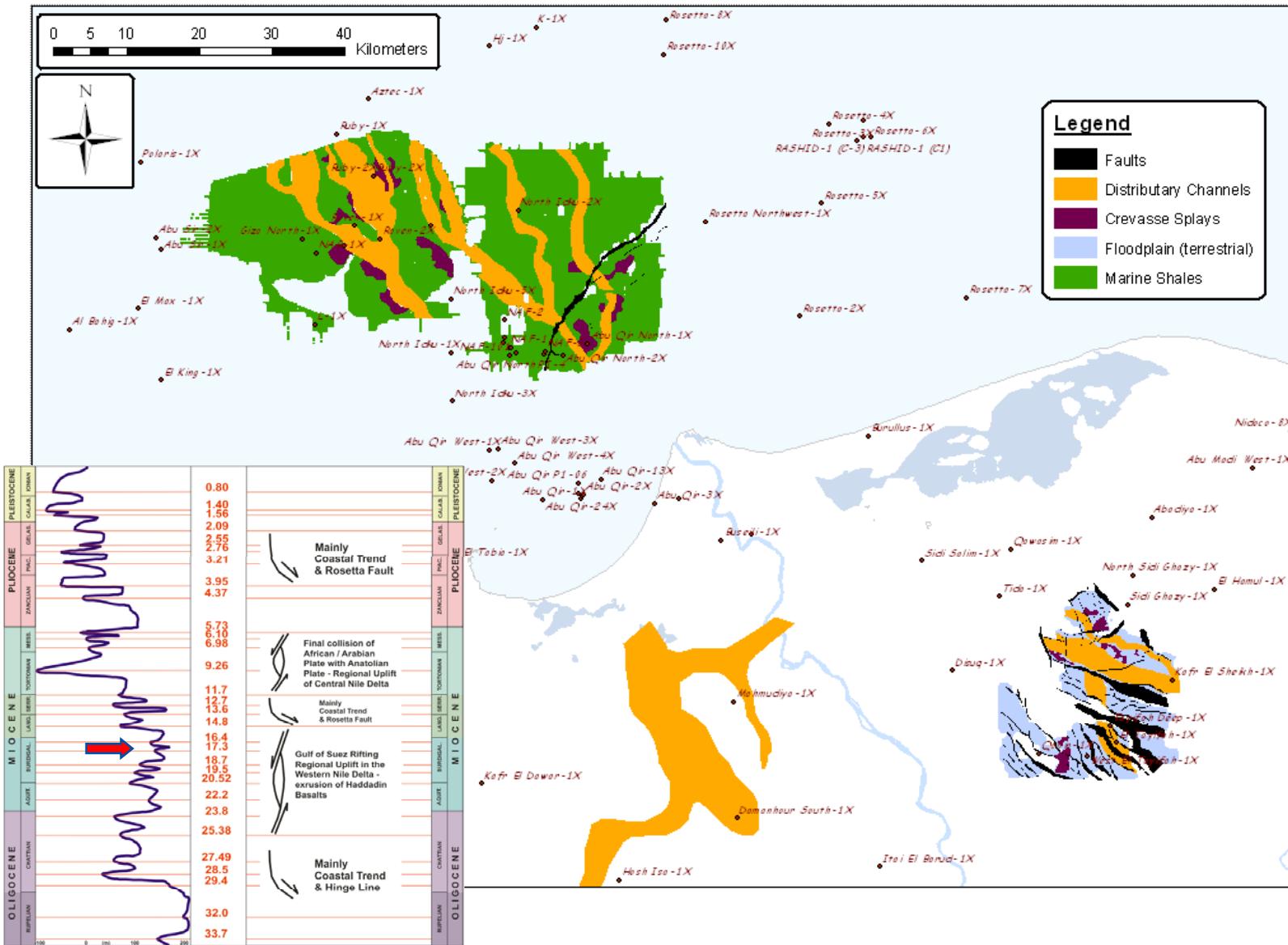
Gross Depositional Environment Map for SB 20.52



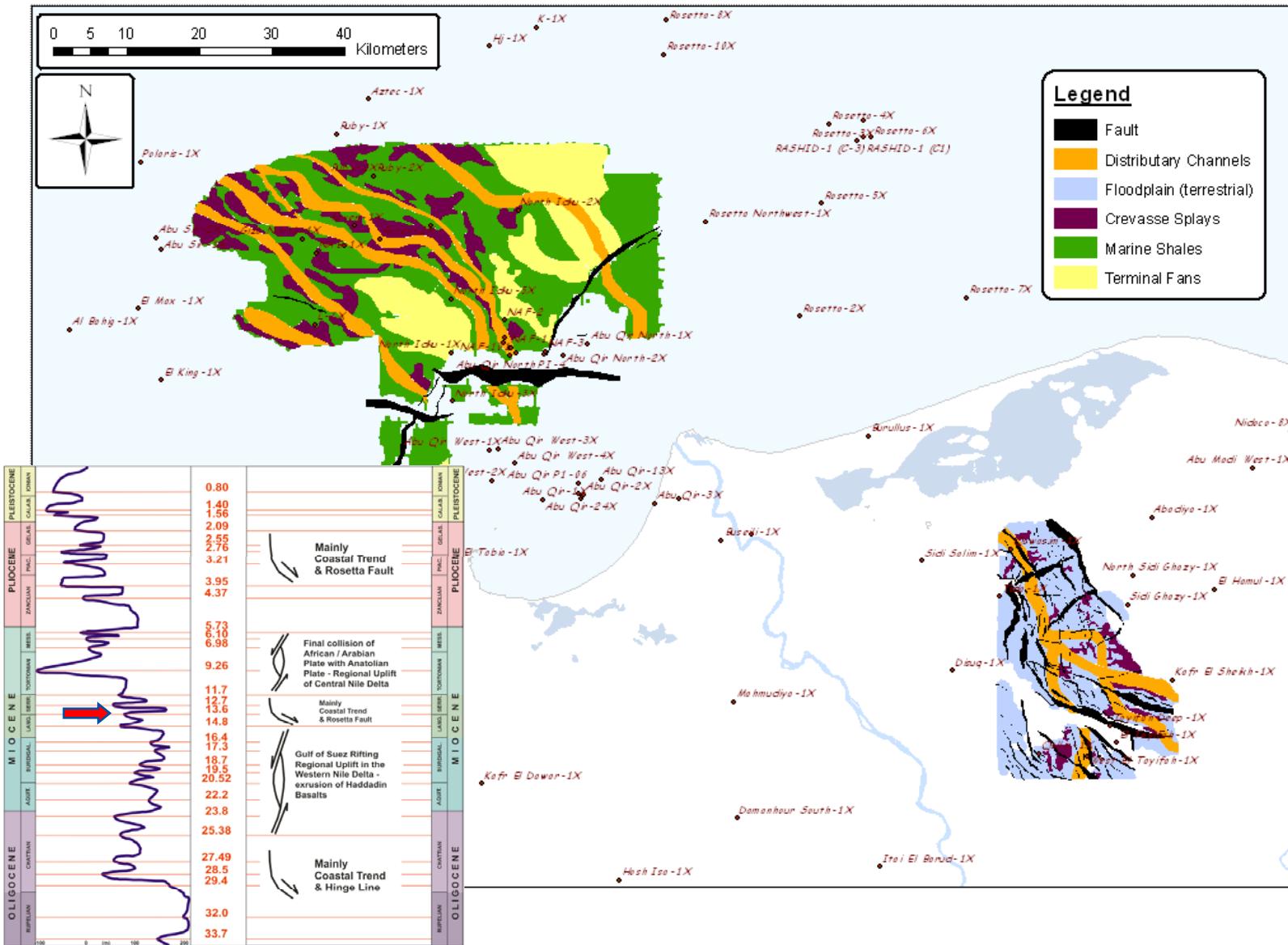
Gross Depositional Environment Map for SB 19.5



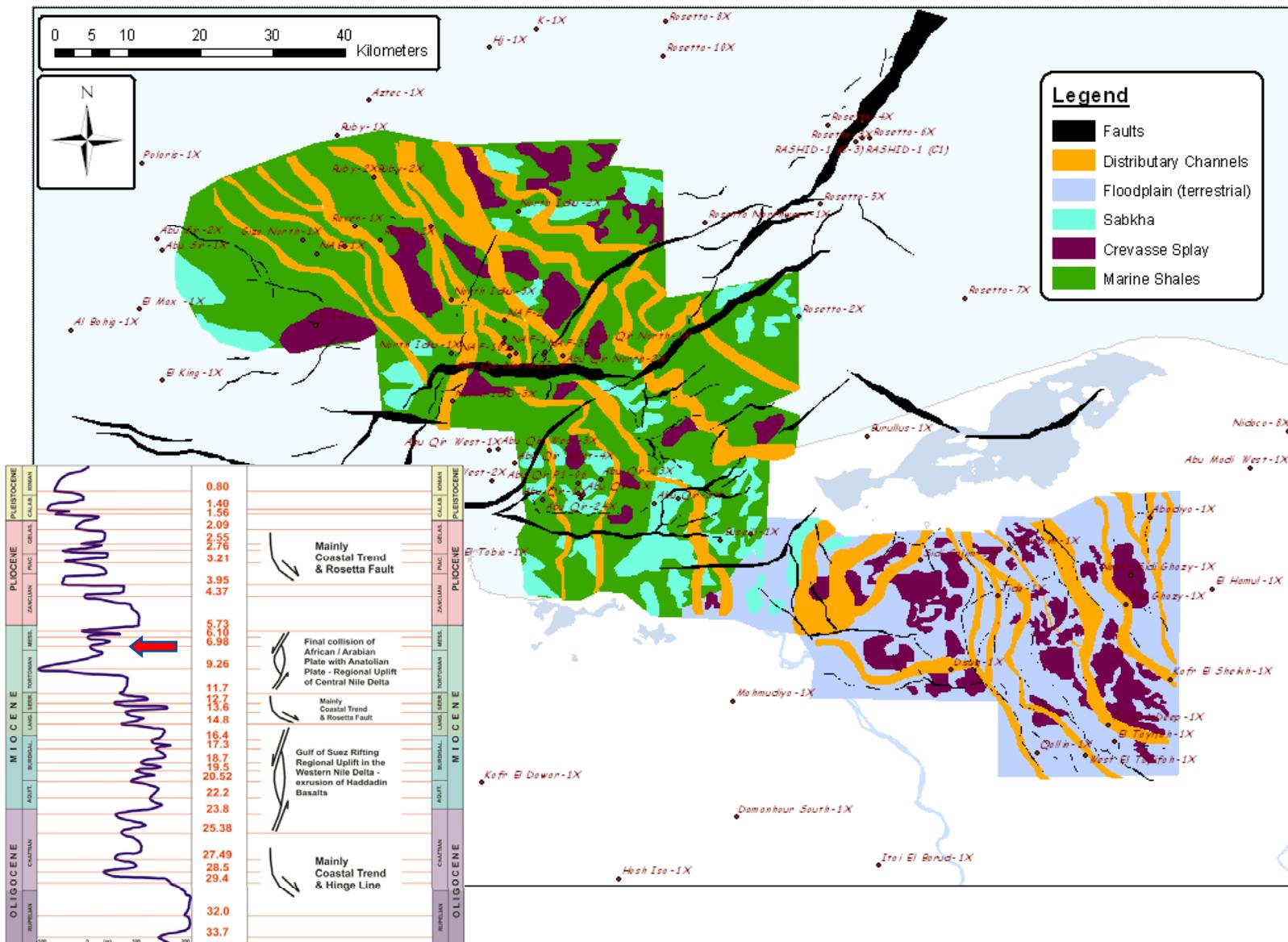
Gross Depositional Environment Map for SB 17.3



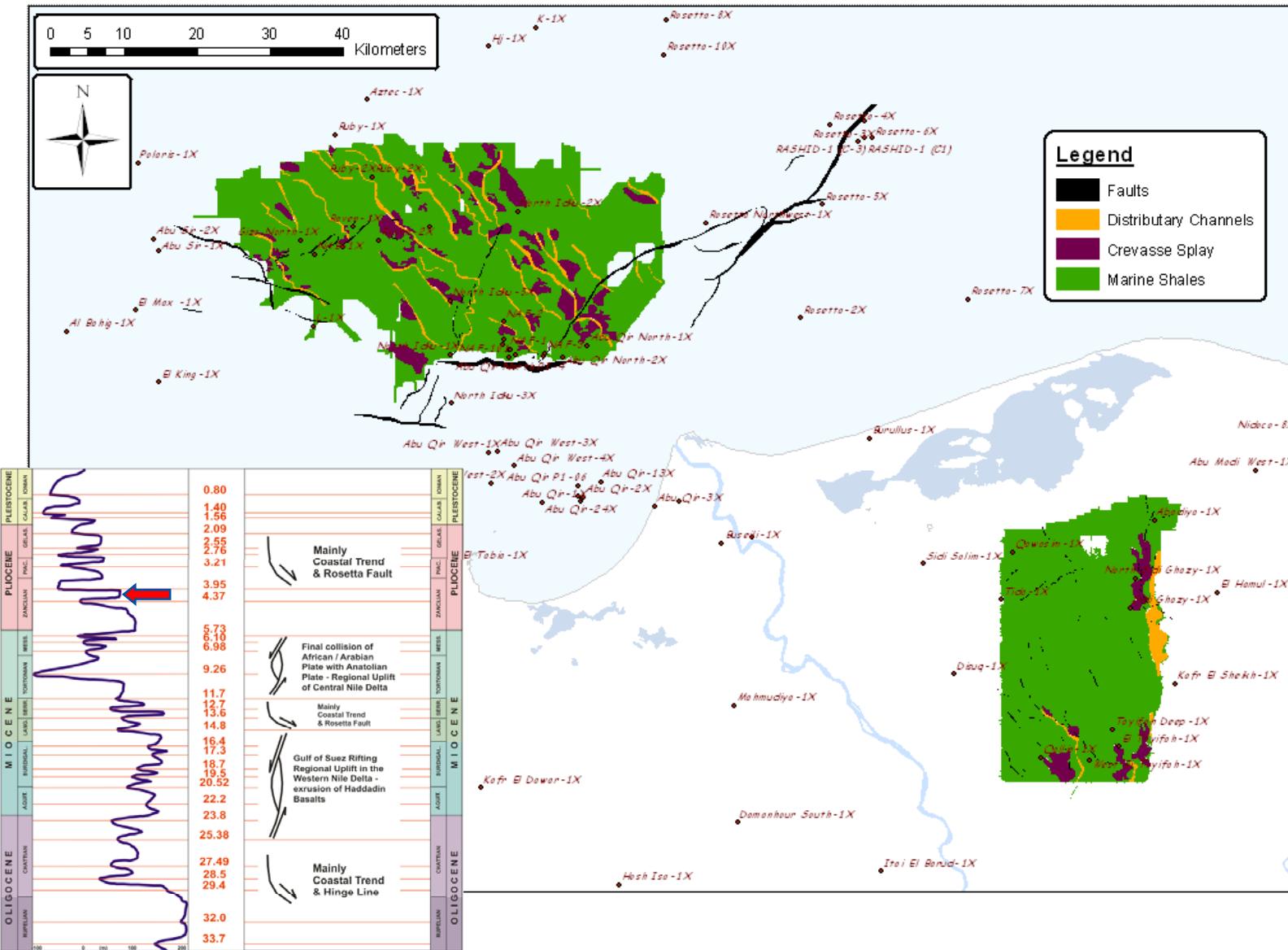
Gross Depositional Environment Map for SB 13.6



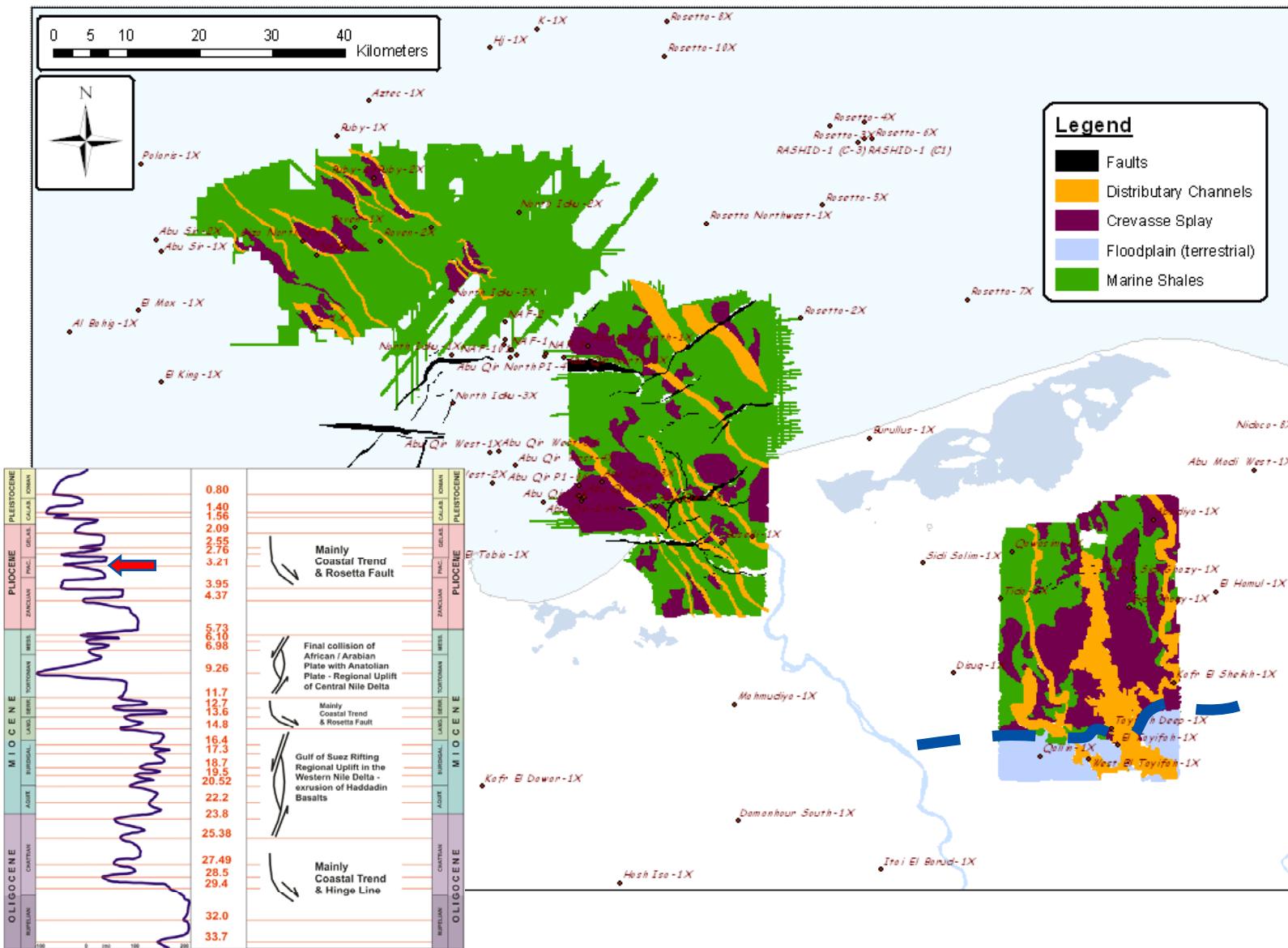
Gross Depositional Environment Map for SB 6.98



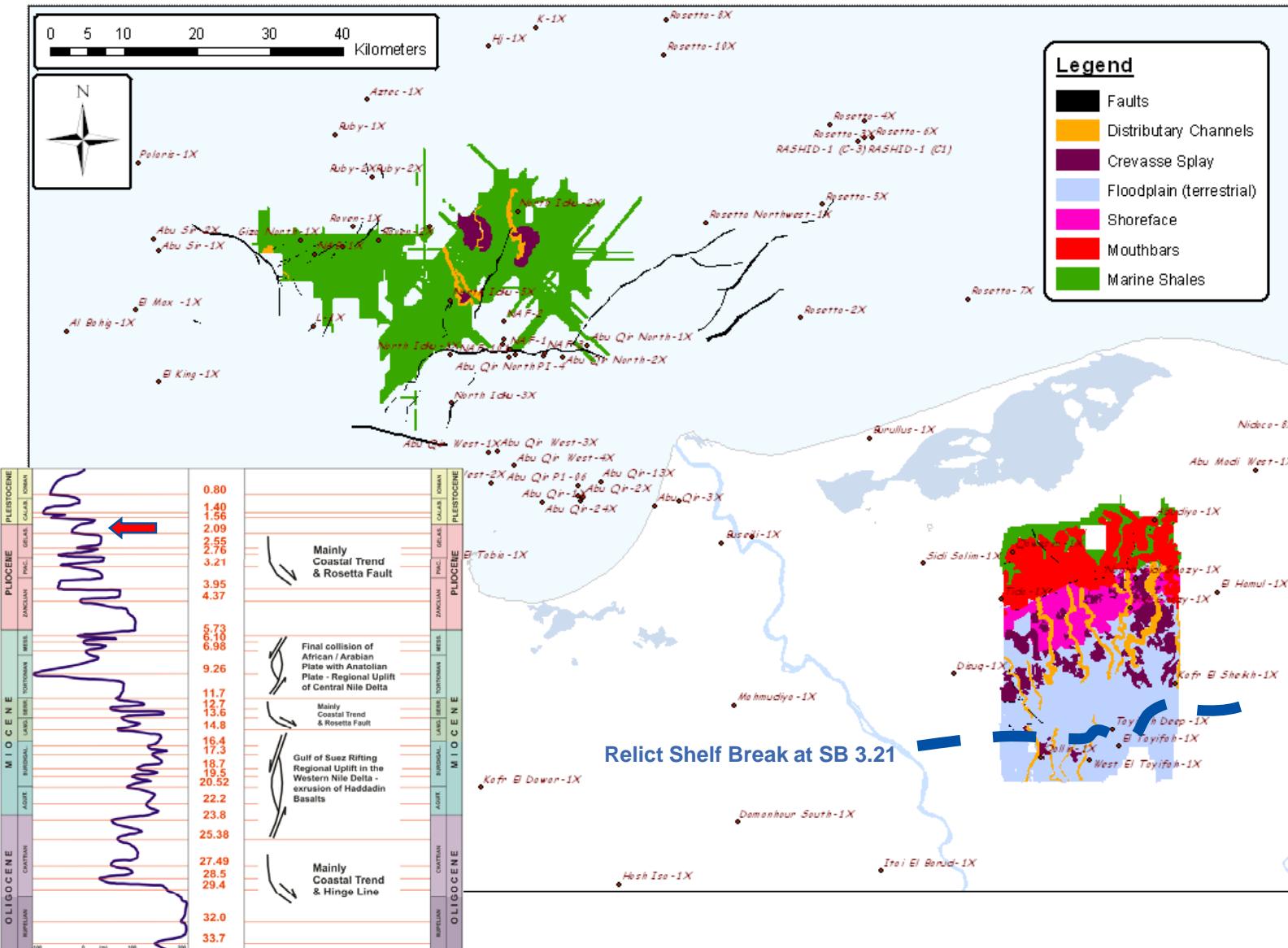
Gross Depositional Environment Map for MFS 4.0



Gross Depositional Environment Map for SB 3.21



Gross Depositional Environment Map for SB 2.09



Conclusion & Lookout

- ❑ Major tectonic events influence depositional patterns at a higher order scale.
- ❑ Miocene deltaic deposition was interrupted by late Tortonian and Messinian hinterland erosion and deposition.
- ❑ Pliocene deltaic deposition commences subsequent to major transgression at base Pliocene.
- ❑ Proven “genetic” methodology approach enables reservoir / seal and migration prediction for successful gas exploration.
- ❑ Results will be complemented by ongoing investigation of infill areas.

Selected References

- Balsley, J.K. and L.R. Parker, 1983, Cretaceous wave-dominated delta, barrier island, and submarine fan depositional systems: Book Cliffs, east central Utah: A field guide: AAPG, 1 volume, irregular pagination.
- GEBCO Digital Atlas, 2003, Intergovernmental Oceanographic Commission and International Hydrographic Organization, part of the General Bathymetric Chart of the Oceans: British oceanographic Data Centre, Liverpool, U.K.: CD-ROM.
- Haq, B.U., J. Hardenbol, P.R. Vail, 1987, The new chronostratigraphic basis of Cenozoic and Mesozoic sea level cycles: Special Publications Cushman Foundation for Foraminiferal Research, v. 24, p. 7-13.
- Haq, B.U., J. Hardenbol, and P.R. Vail, 1987, Chronology of fluctuating sea levels since the Triassic: Science, v. 235/4793, p. 1156-1167.