Unconventional Petroleum Plays in the Mediterranean Basins*

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Abstract

Exploration for unconventional petroleum in Europe has intensified over the last five years. The potential for unconventional oil and gas resources has been examined in order to determine the right types of rock, basin and maturity in basins around the Mediterranean Sea. Various target shale formations exist in the study area, ranging in age from the Lower Paleozoic to Tertiary. These shales are of very good geochemical quality, both in their Total Organic Carbon content, as well as in their hydrogen indices. The basins containing these rocks vary in their tectonic style, but they are often structurally "quiet" synclines or monoclines. The maturity of the shales has been found to be in the oil and gas window. Models for source rock deposition demonstrate the possibility of black shale deposition throughout the Paleozoic, Mesozoic and Cenozoic eras in various areas of the Mediterranean.

International oil companies explore for unconventional petroleum resources in several European Mediterranean countries. However, unconventional exploration has not started in earnest in North Africa, south Balkans, Near East or Middle East. Target shales for shale-gas, shale-oil and pyrolysed oil exist in Greece, Turkey, Israel and in the north African region. The purpose of the current study is to highlight areas of unconventional petroleum prospectivity in the Mediterranean region.

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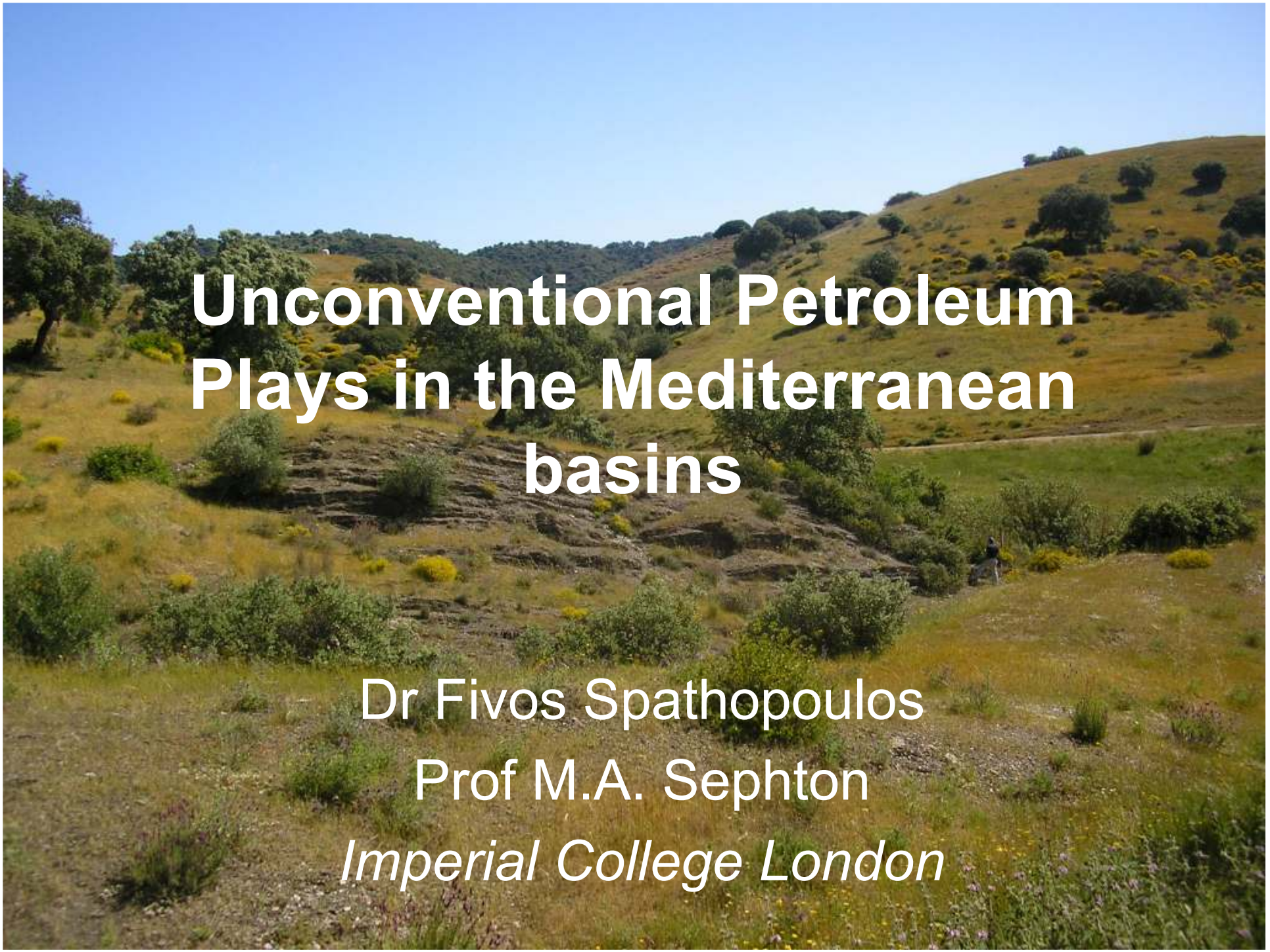

Unconventional Petroleum Plays in the Mediterranean basins

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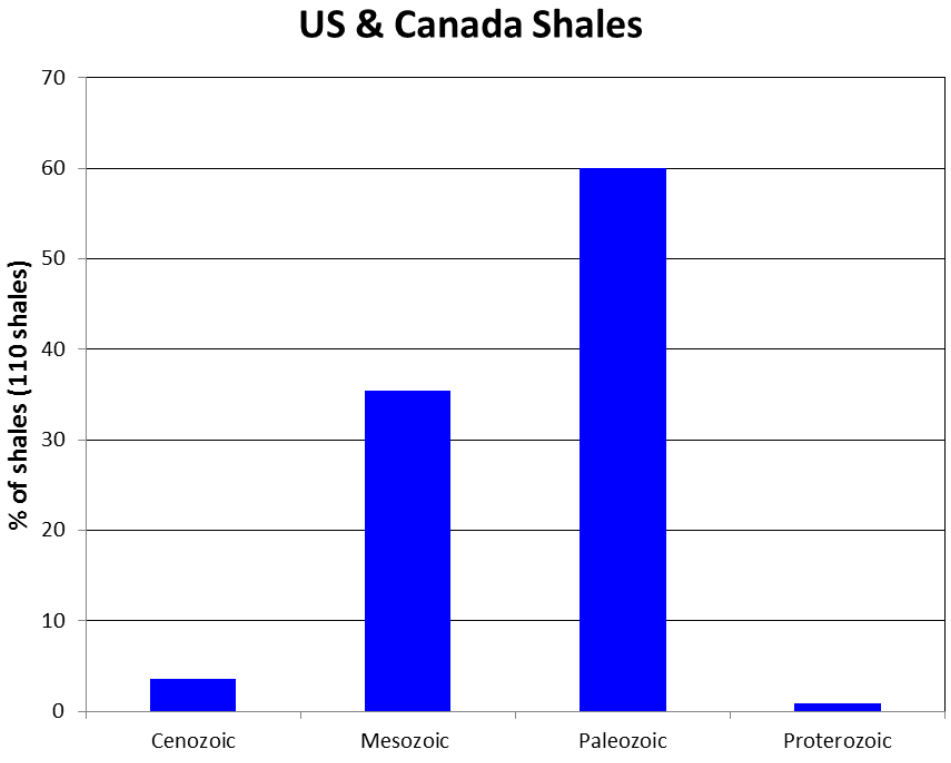
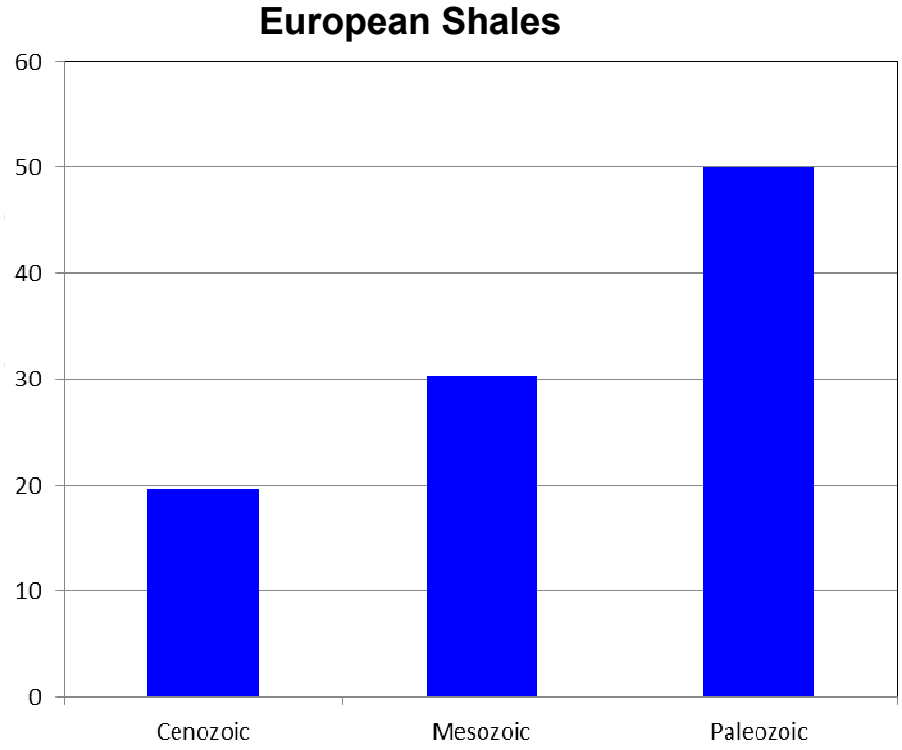
Prof M.A. Sephton

Imperial College London

Comparison by Era

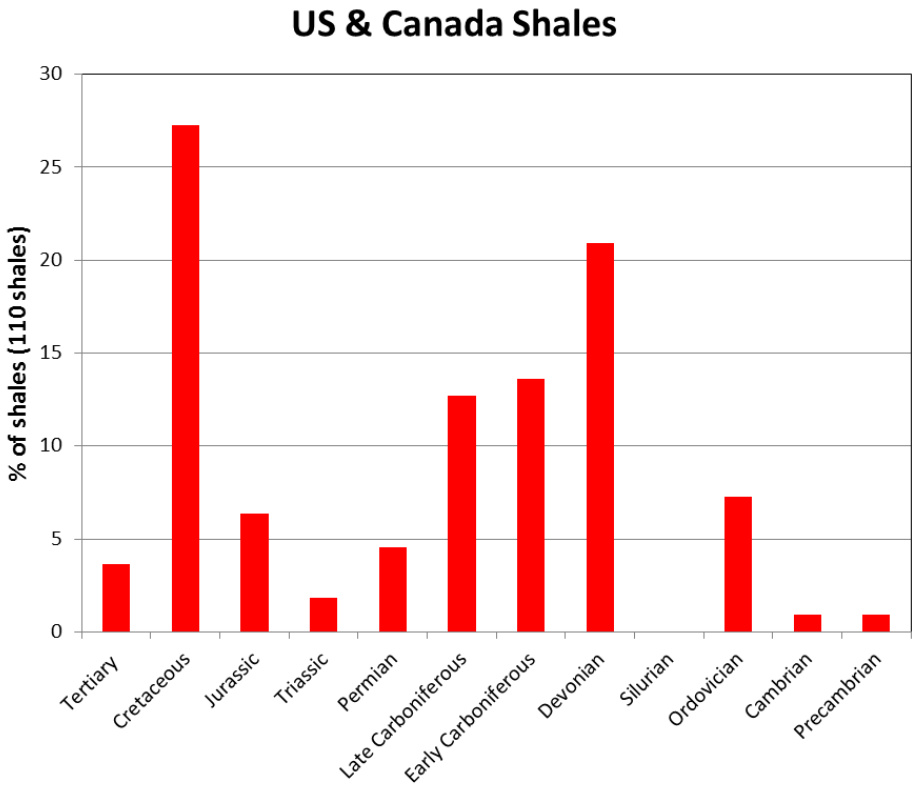


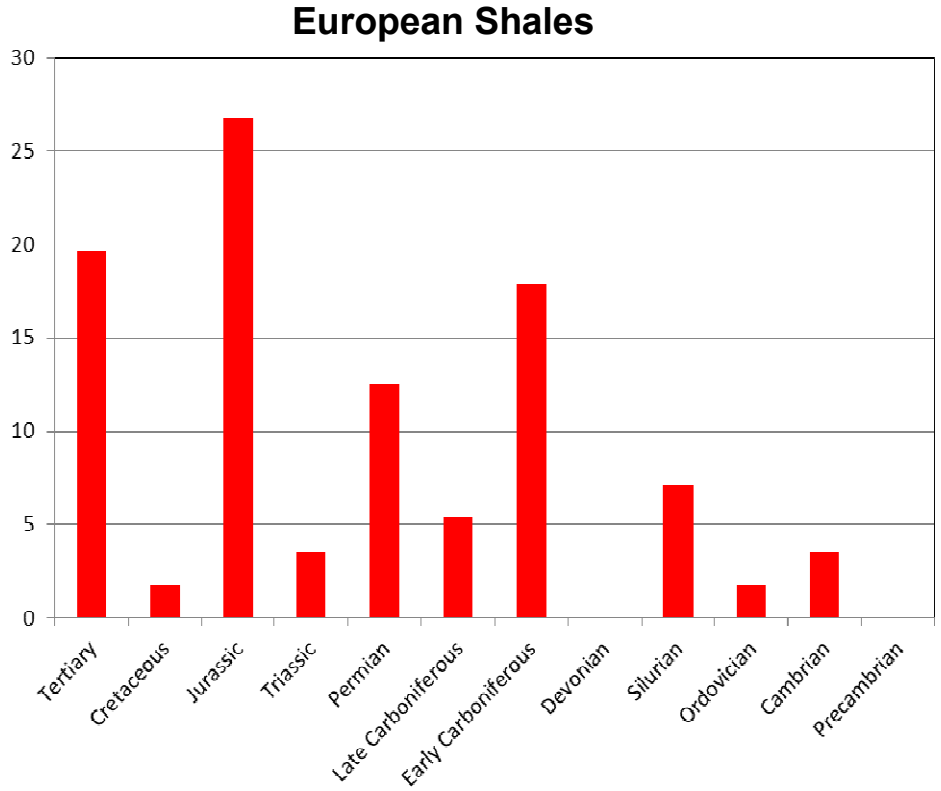


Statistics on 110 shales

Statistics on 56 shales

Comparison by Epoch

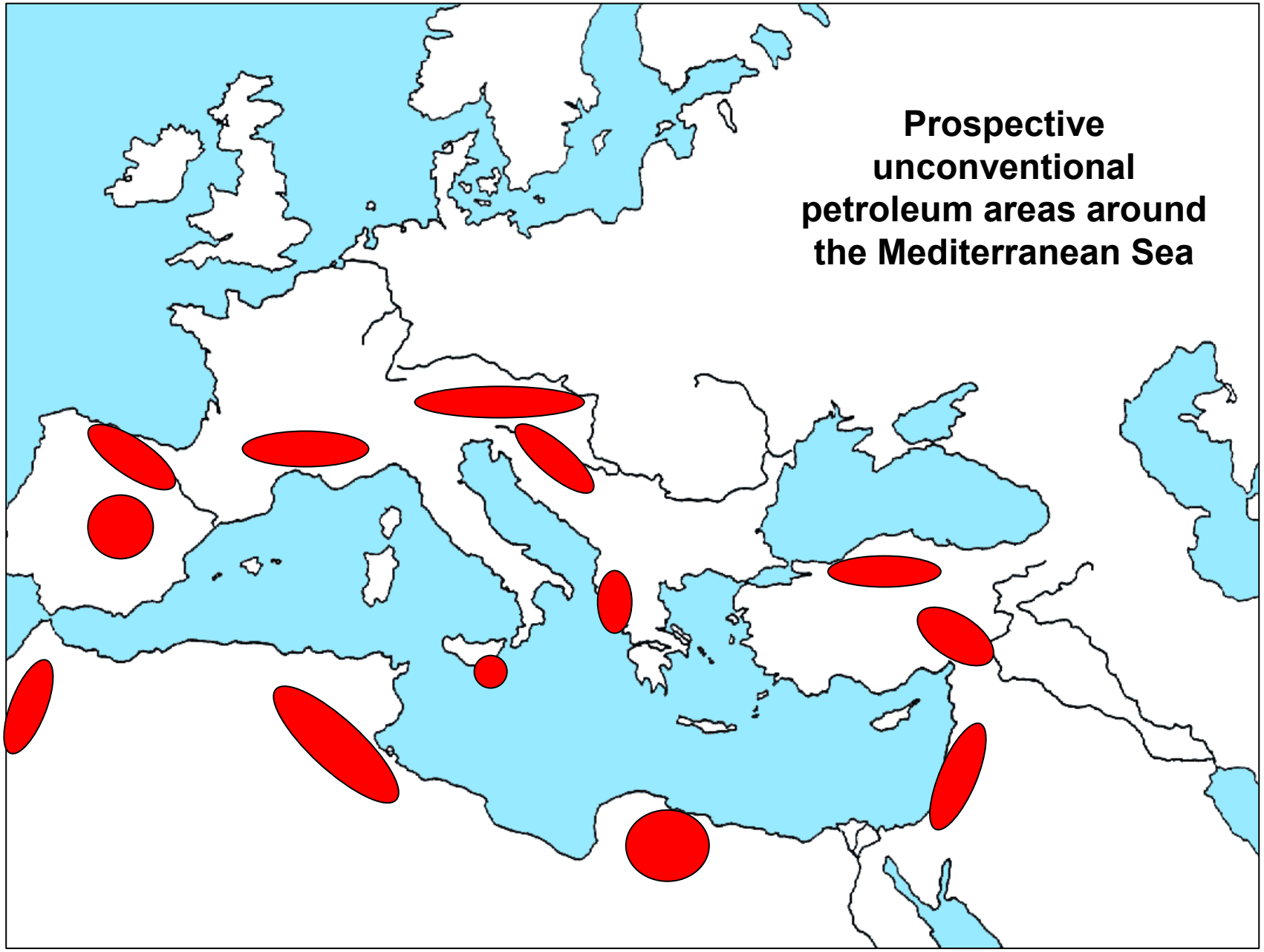




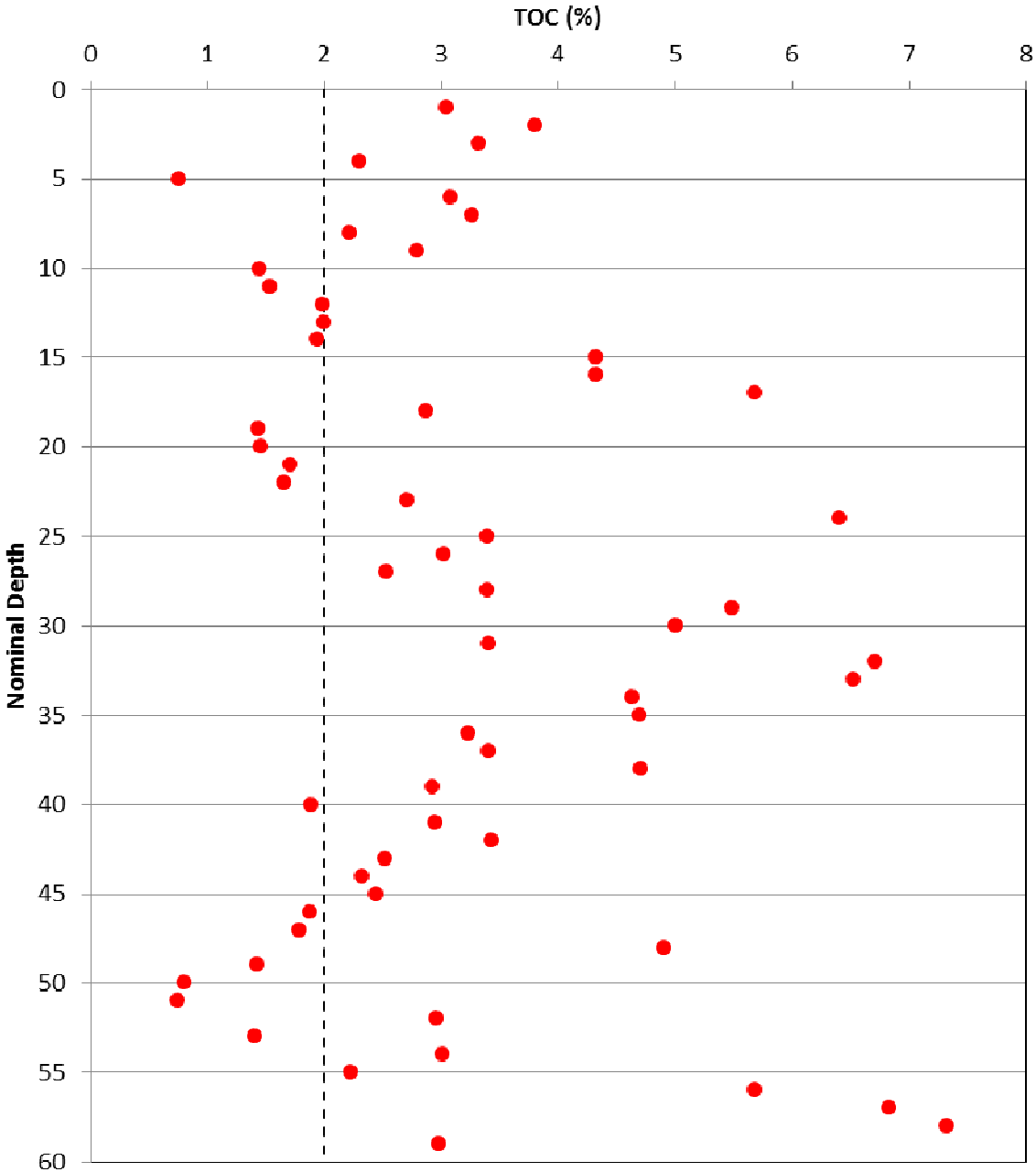
Statistics on 110 shales

Statistics on 56 shales

The big shale fairways around the Mediterranean Sea

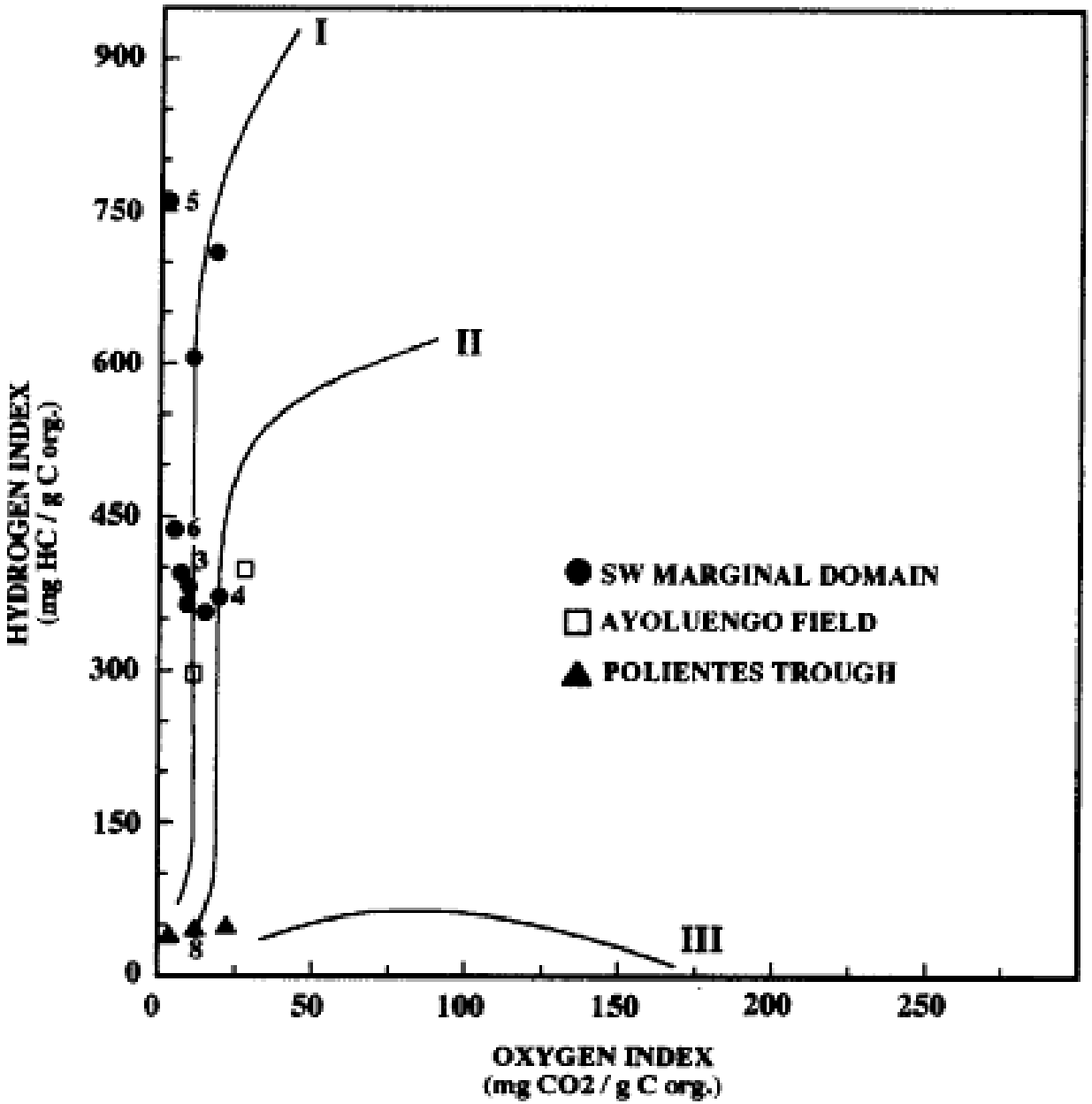

Prospective
unconventional
petroleum areas around
the Mediterranean Sea

Spain



Lias (Pliensbachian) shales in the Asturian Basin

BORREGO‘ A.G. et al, 1996: The Pliensbachian (Early Jurassic) "anoxic" event in Asturias, northern Spain: Santa Mera Member, Rodiles Formation. Org. Geochem. Vol. 25, pp. 295-309



Lias (Pliensbachian) shales in the Basque-Cantabrian Basin

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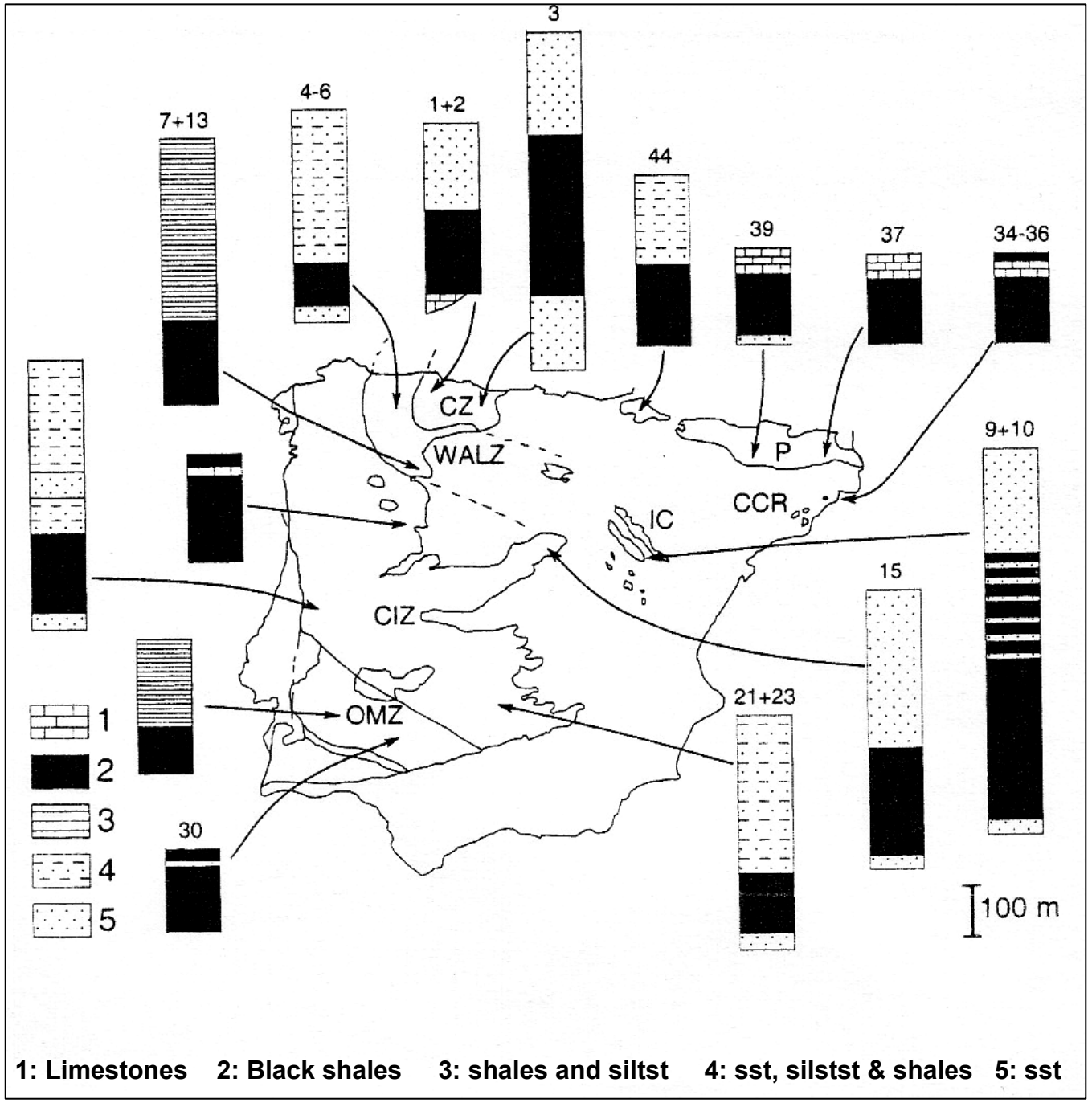


Silurian sections in the Iberian Peninsula

CCR: Catalonian Coastal Ranges

CIZ: Central Iberian Zone

CZ: Cantabrian Zone

IC: Iberian Cordillera

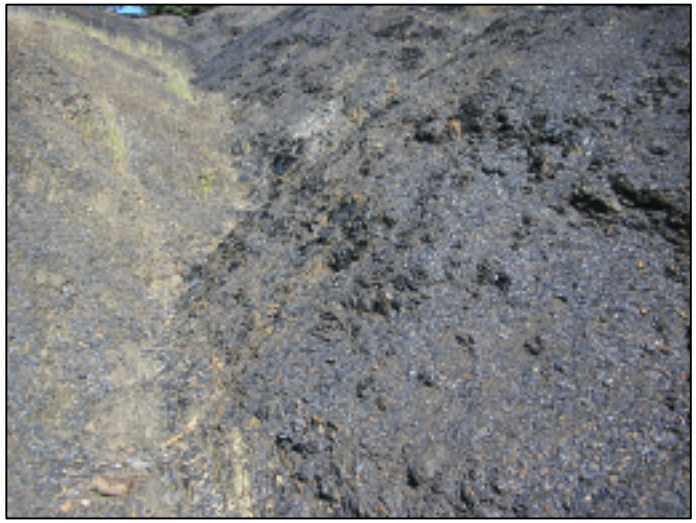
OMZ: Ossa Morena Zone

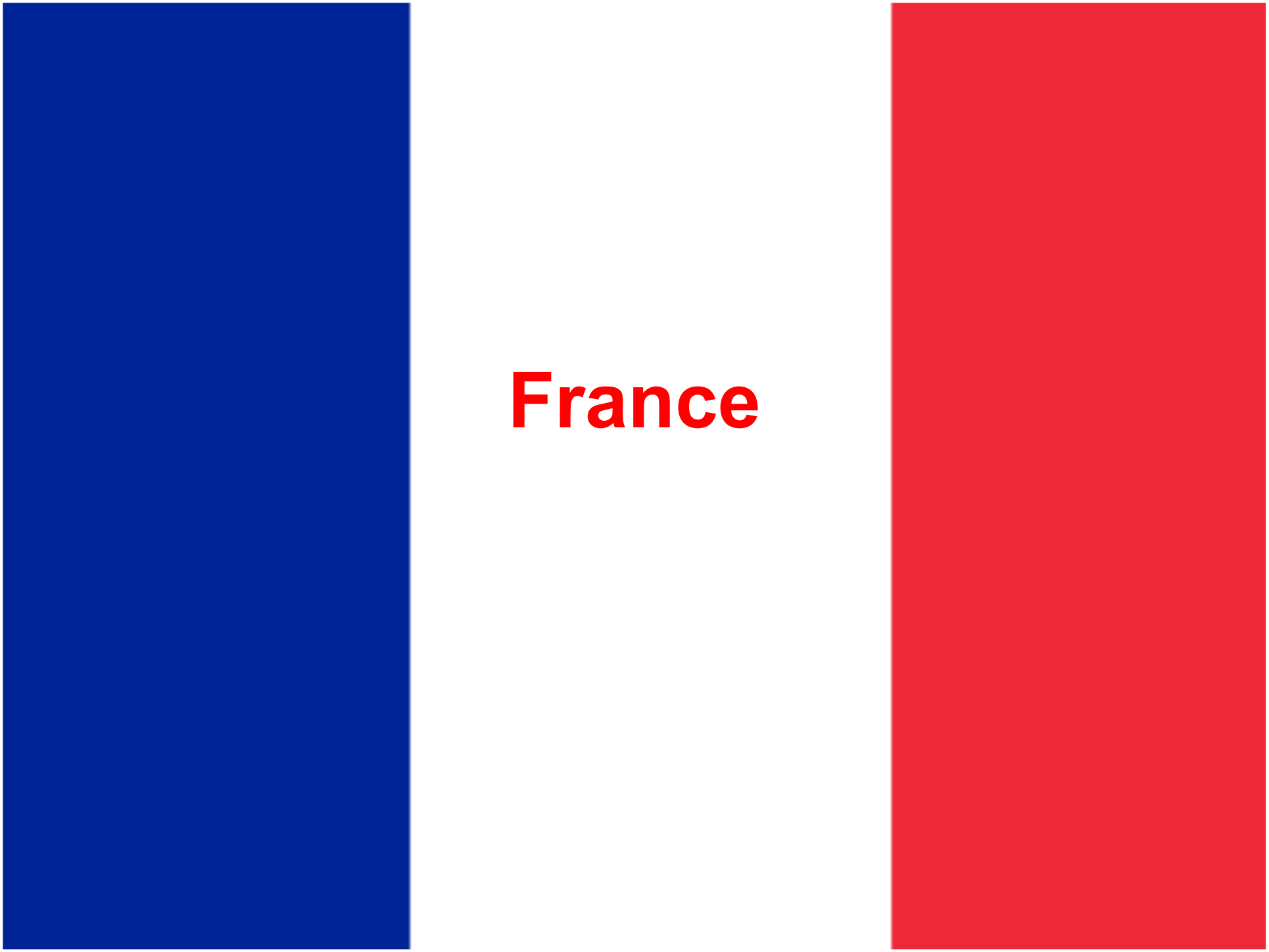
P: Pyrenees

WALZ: West Asturian-Leonese Zone

From: Guttierez-Marco J.C., Robardet M. & Piçarra J.M. (1998). "Silurian Stratigraphy and Paleogeography of the Iberian Peninsula". *In:* Proceedings 6th Graptolite Conference, Temas Geológico-Mineros ITGE, vol 23

Silurian shale outcrops in Central Spain




France

Upper Carboniferous (Stephanian) black shales, Boson coal mine

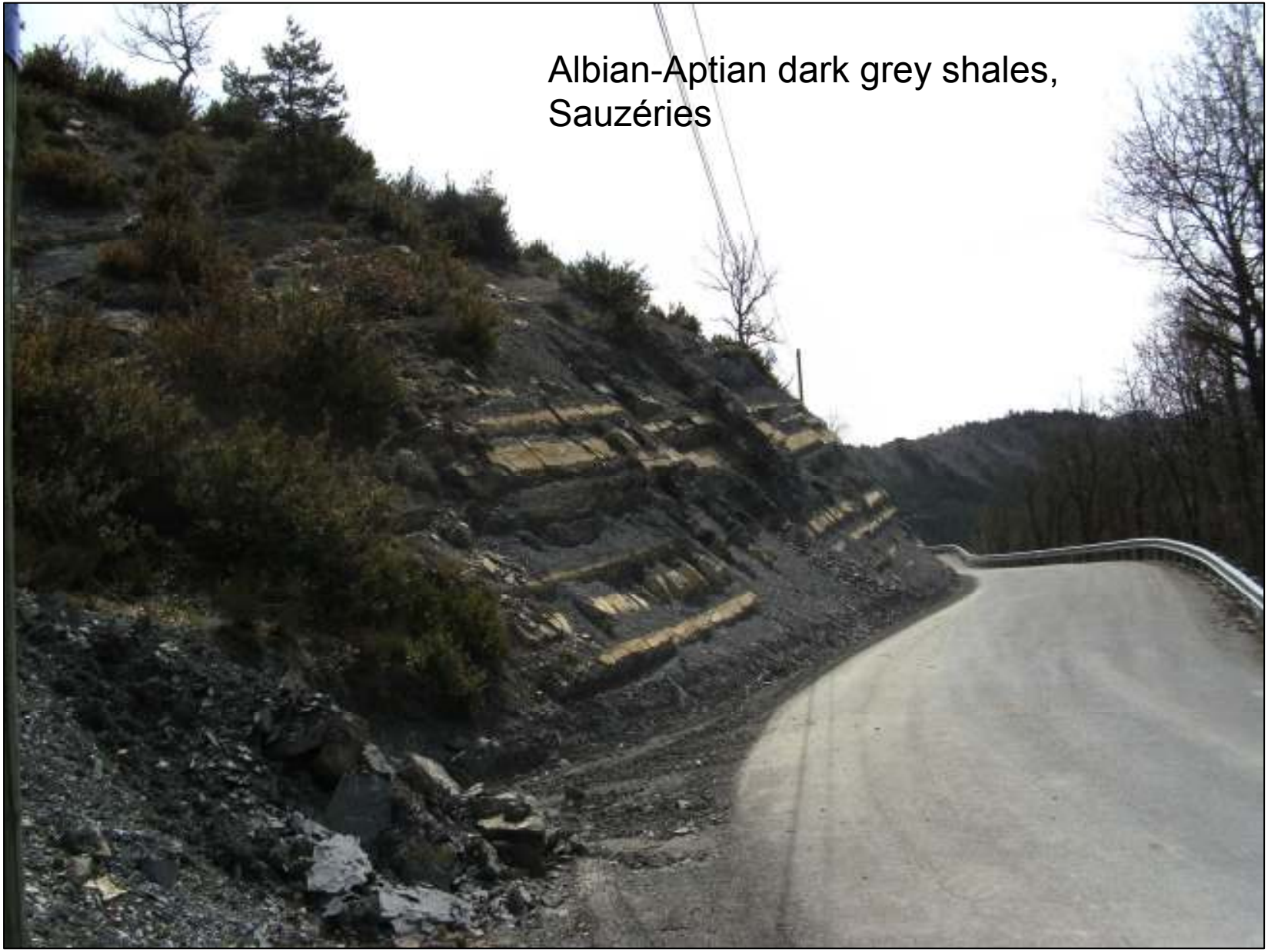
Early Permian “Autunian” black lacustrine shales, Languedoc

TOC %	HI
1.06	156
7.89	390
3.79	202


Schistes carton,
Curbans


Terres Noires (Oxfordian),
Entreaunes

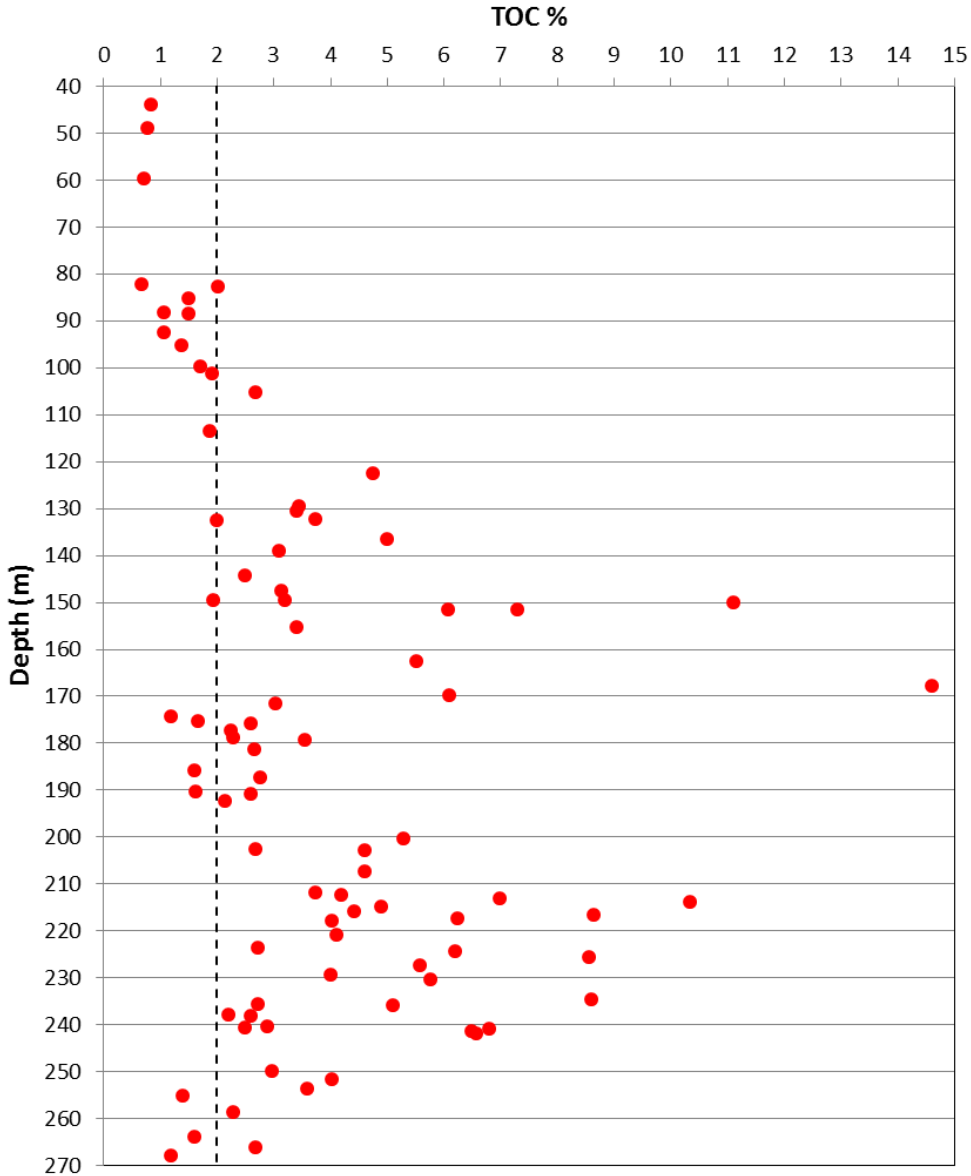

Terres Noires (Oxfordian),
Villeneuve d’Entreaunes

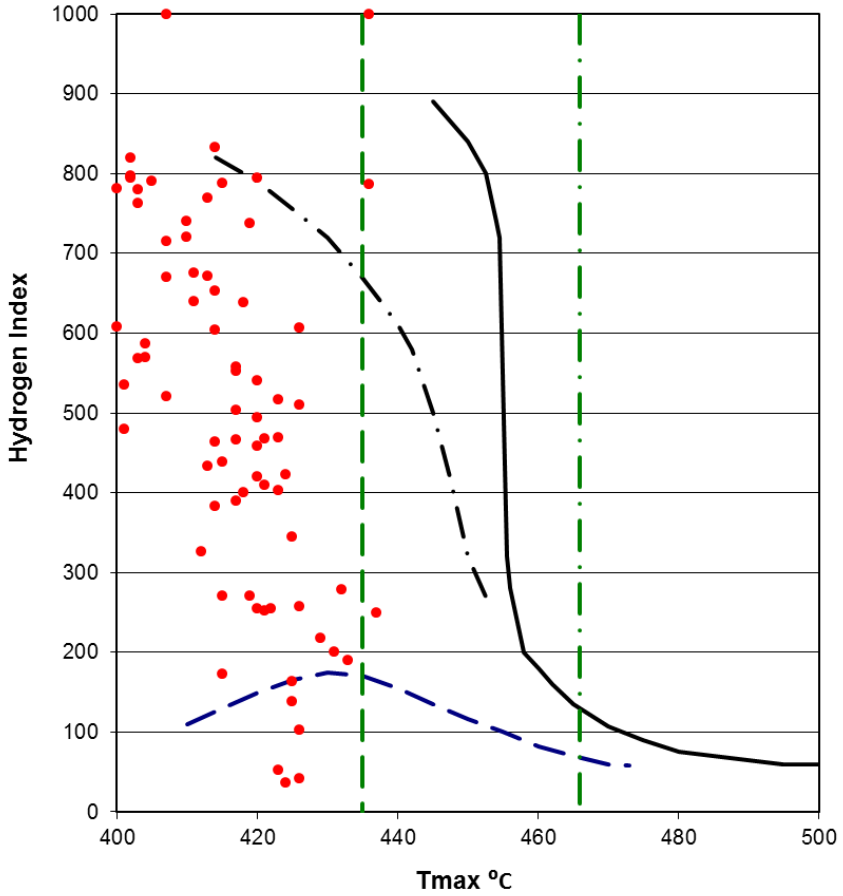

Albian-Aptian dark grey shales,
Sauzéries

Cenomanian dark grey-black shales, Vallée de Vesubie


Italy

Upper Triassic Kössen Formation, northern Italy





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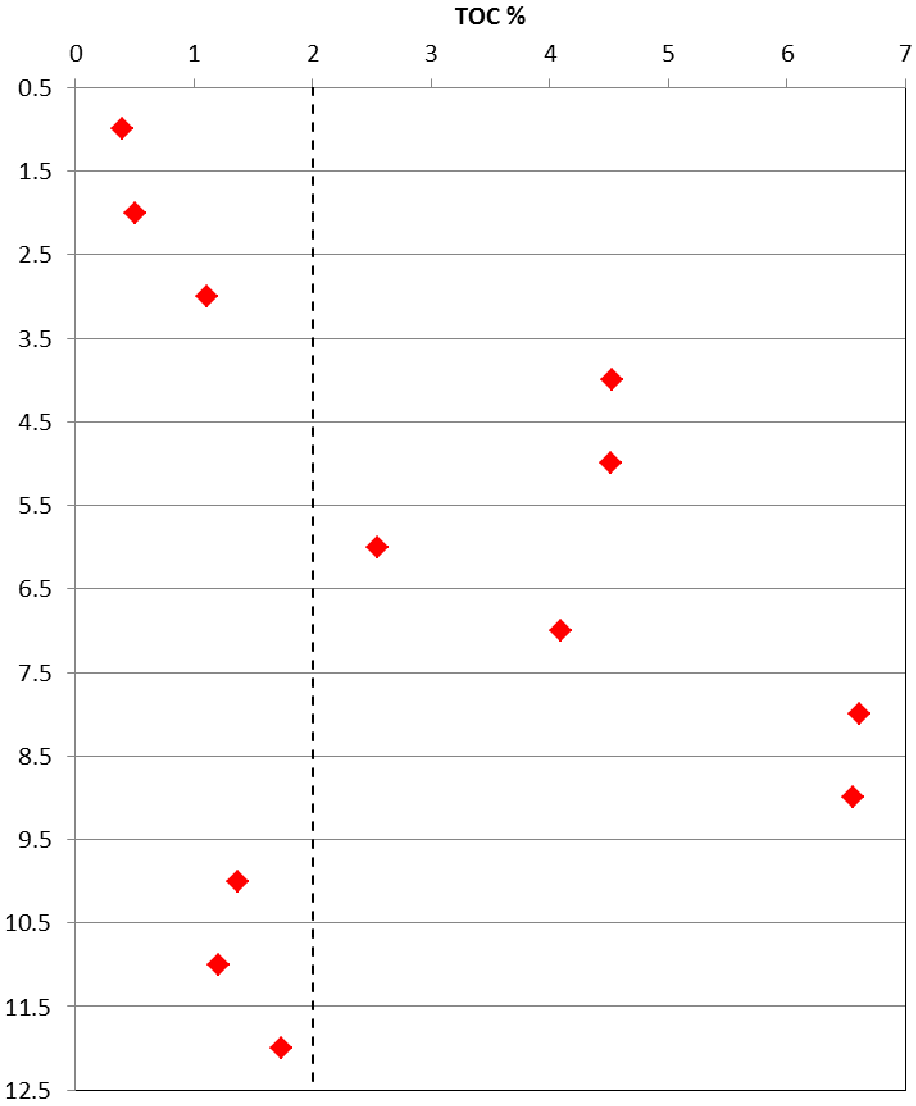
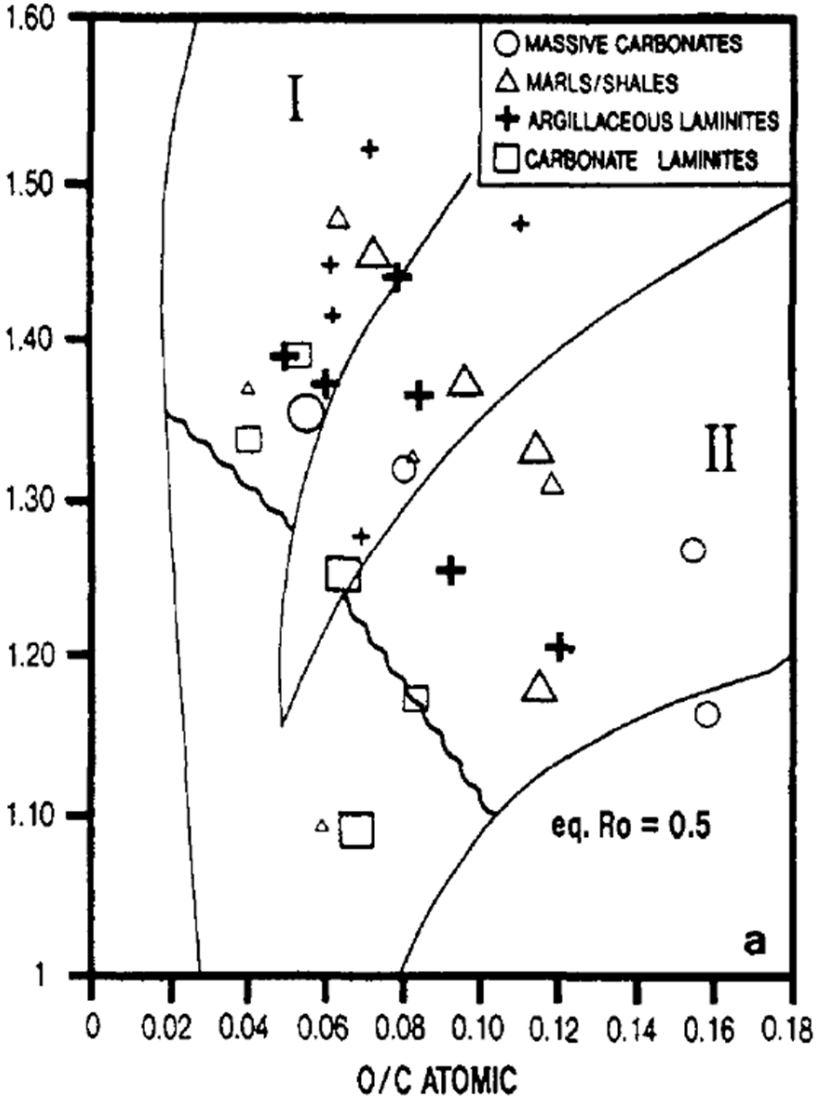
Triassic Noto Formation, Sicily





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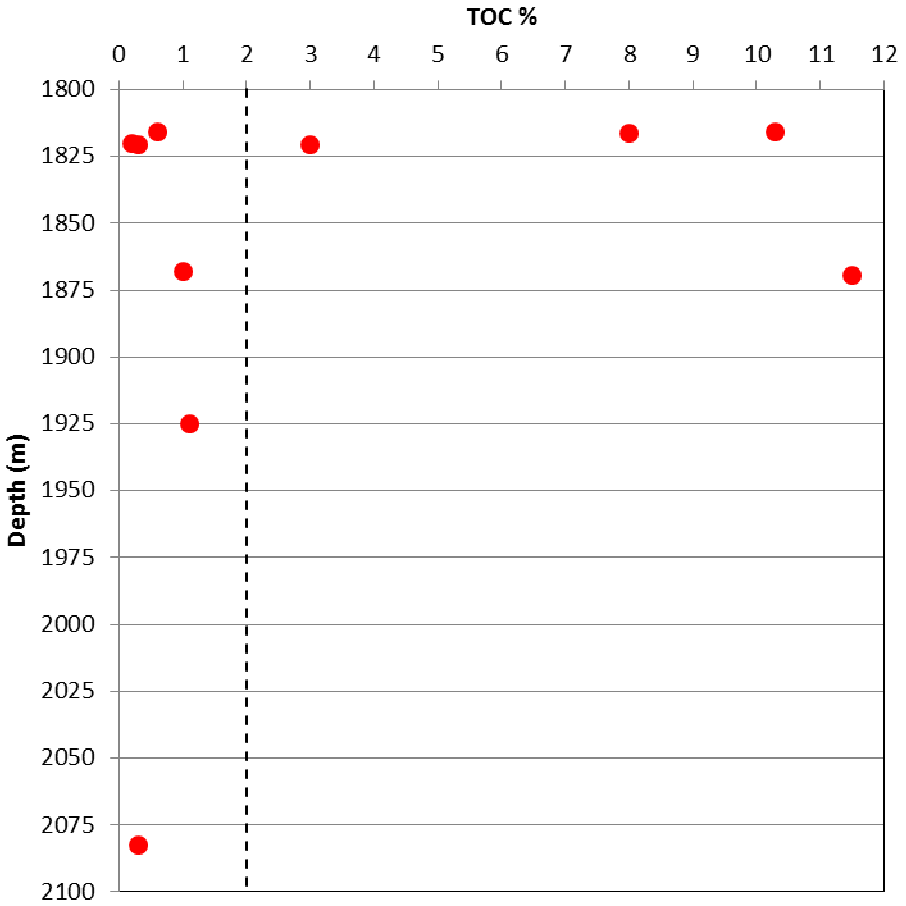

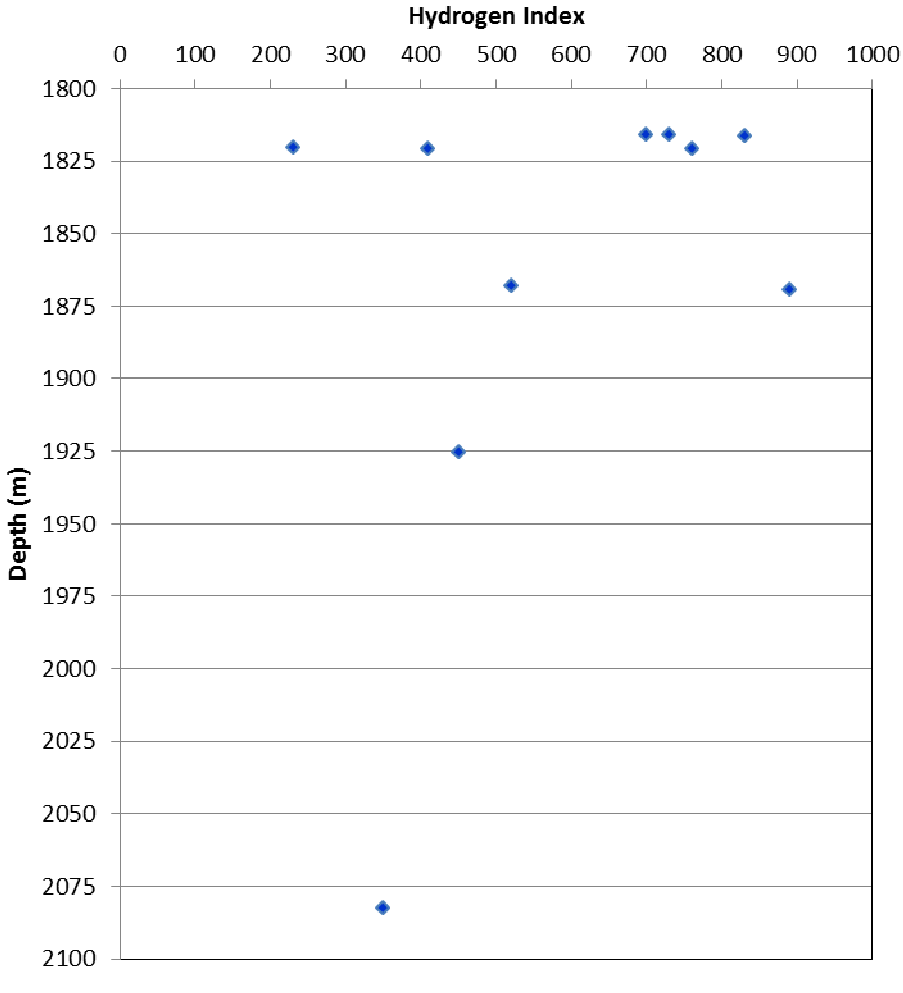

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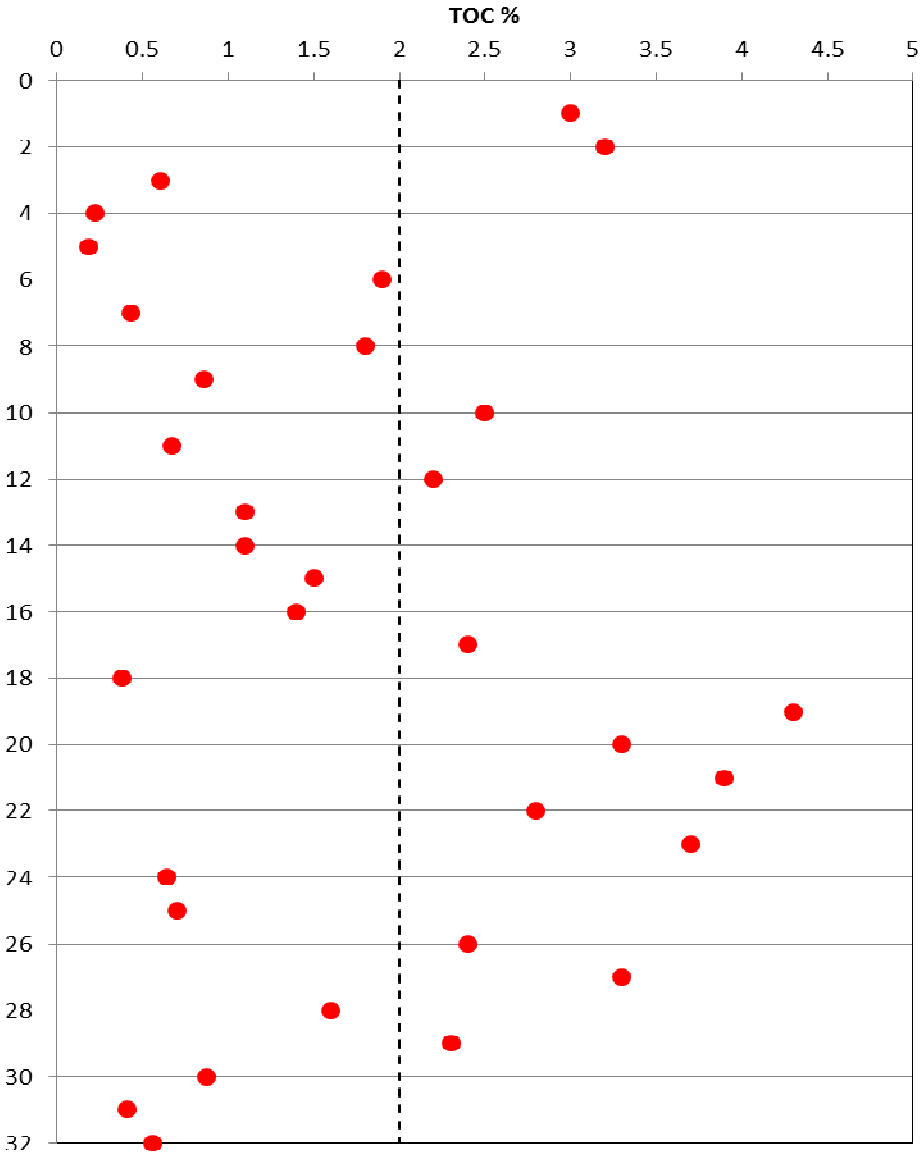
Liassic Posidonia Shale in northern Italy



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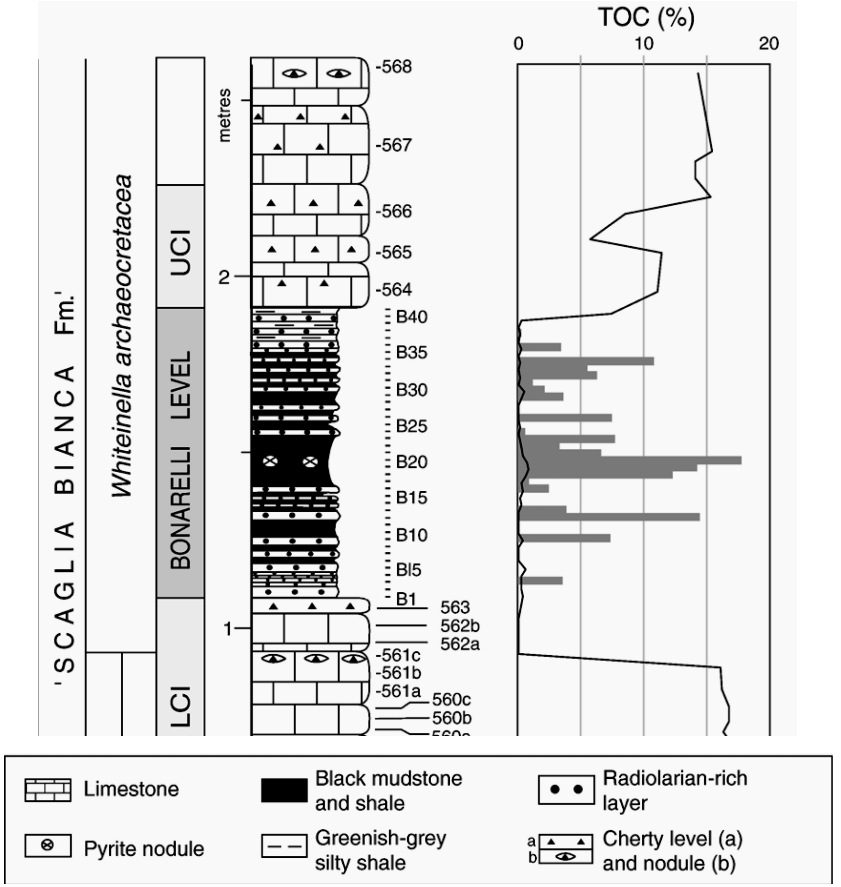
Cenomanian-Turonian *Bonarelli* shales, Appenines



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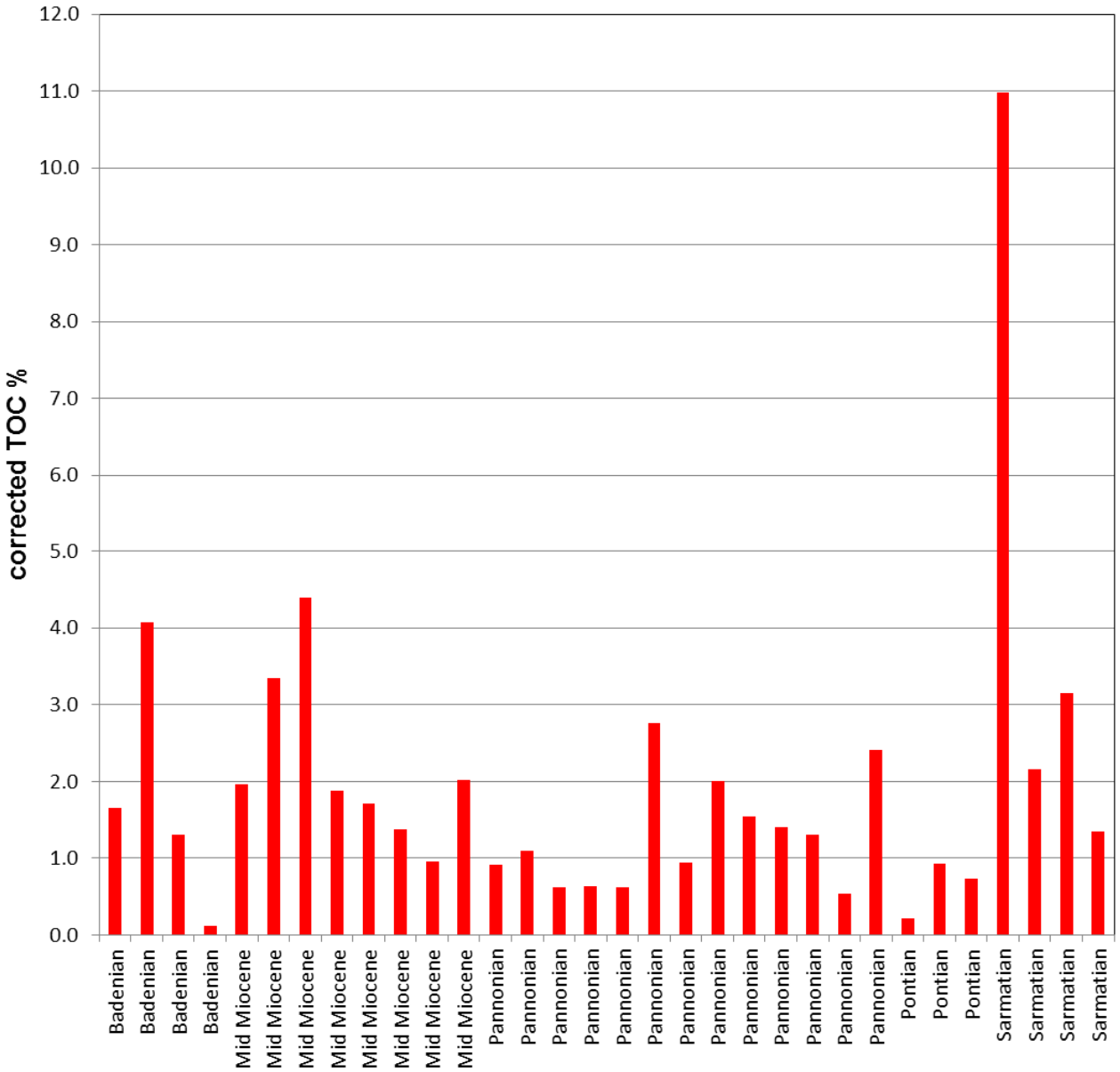
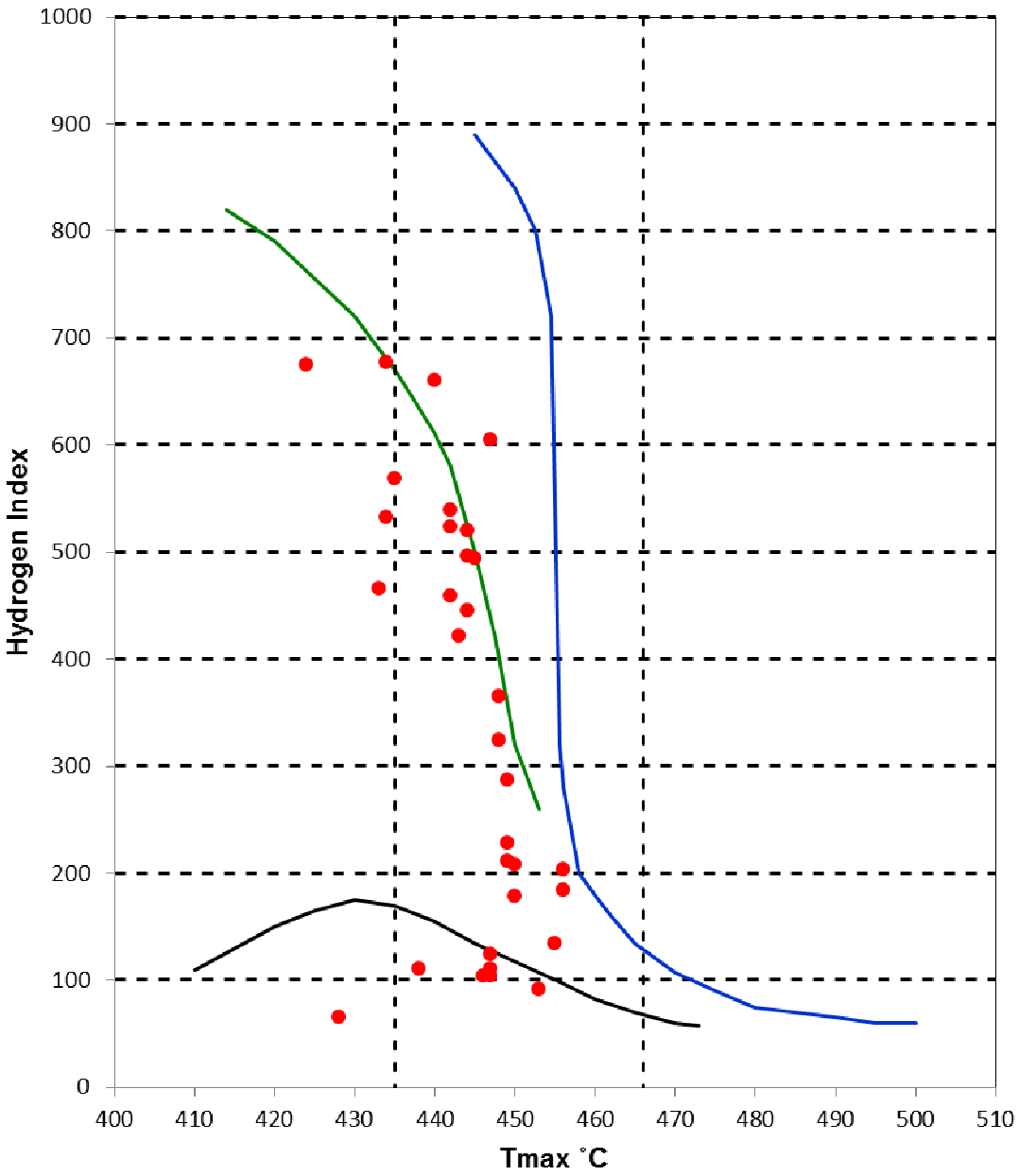
Slovenia, Croatia, Serbia, Bosnia & Herzegovina



Miocene source rocks in the Pannonian Basin

Mrkič S. (2011): Organic geochemistry of Miocene source rocks from the Banat Depression (SE Pannonian Basin, Serbia). Organic Geochemistry 42, p. 655–677



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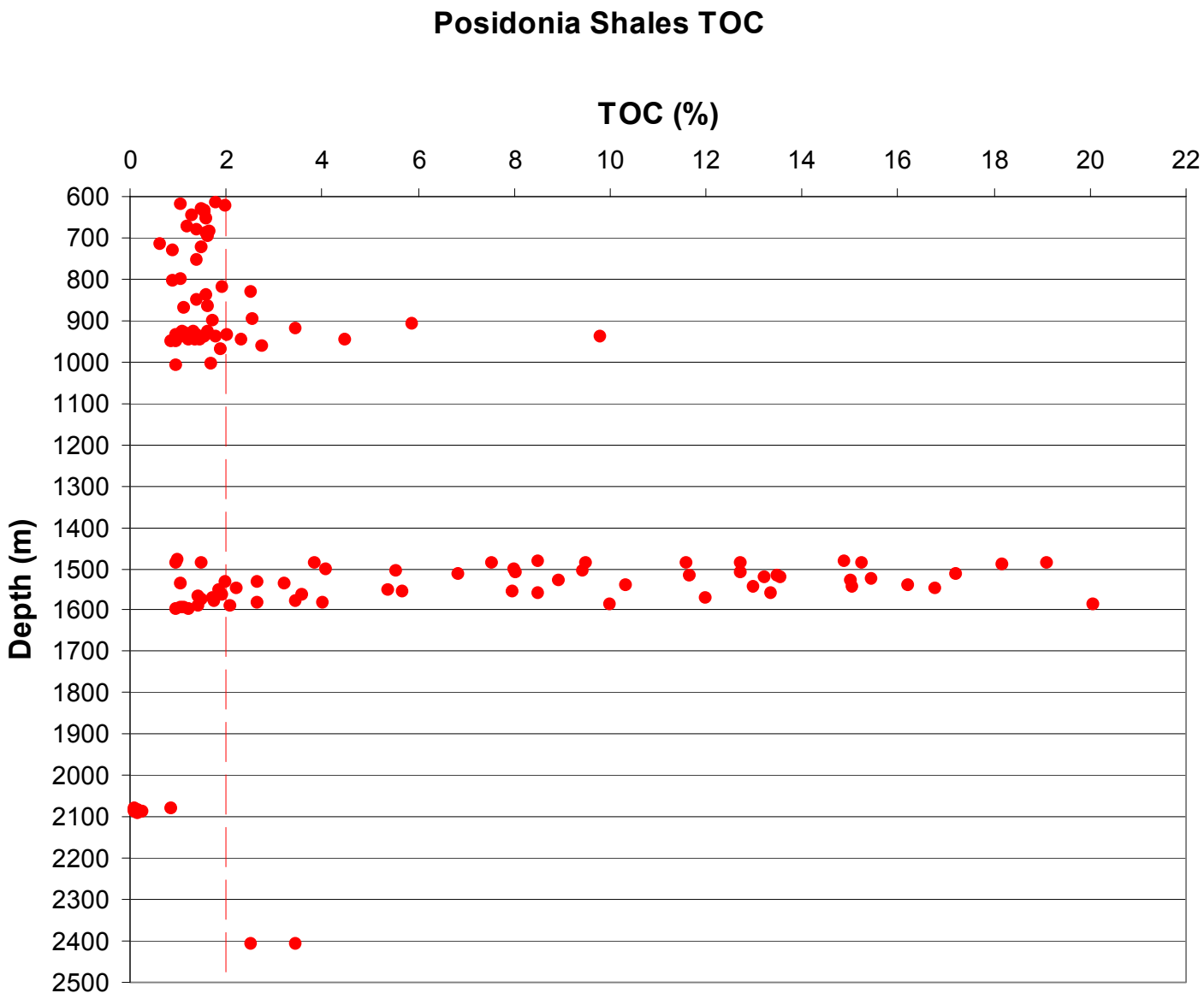
Greece



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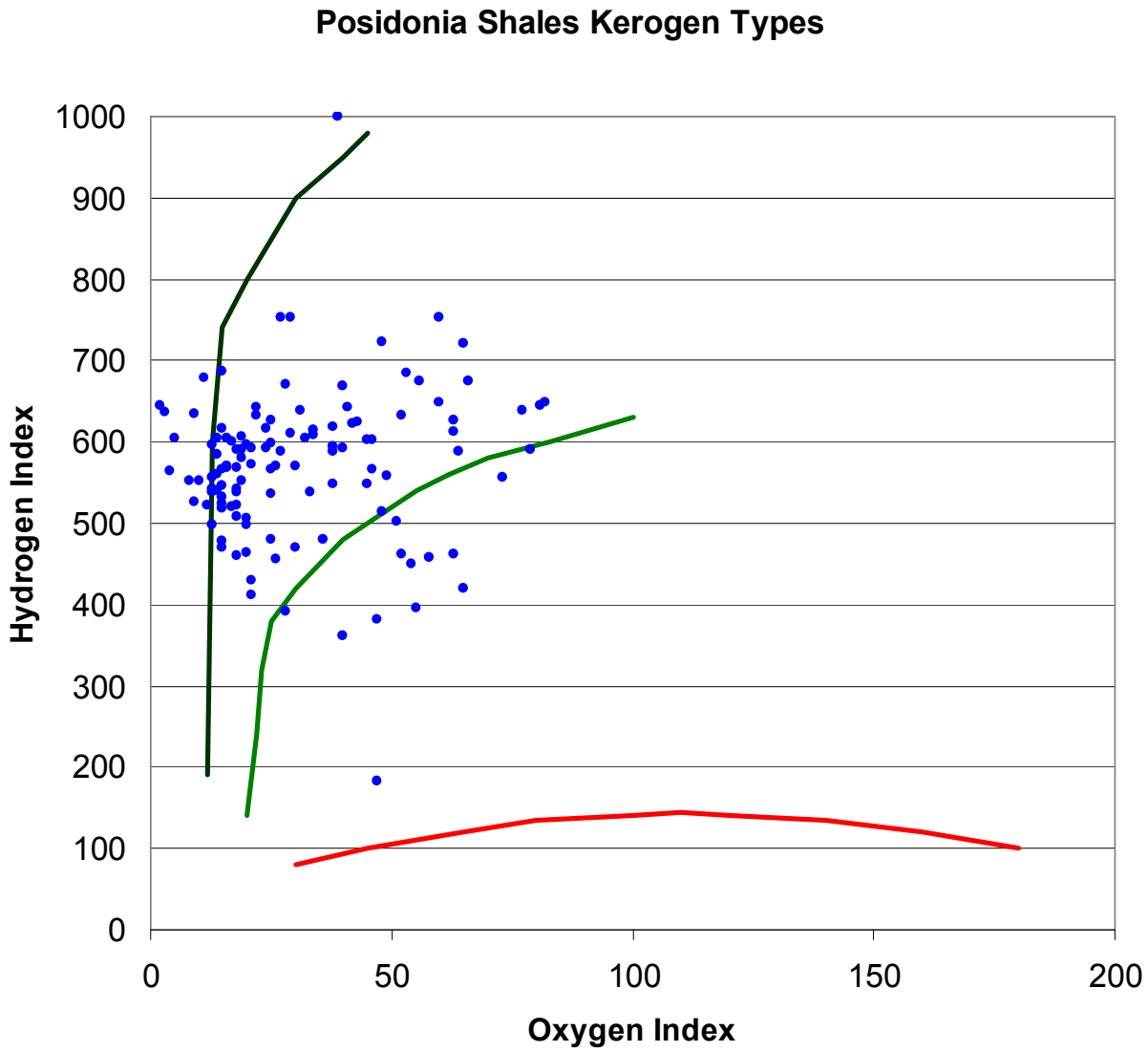

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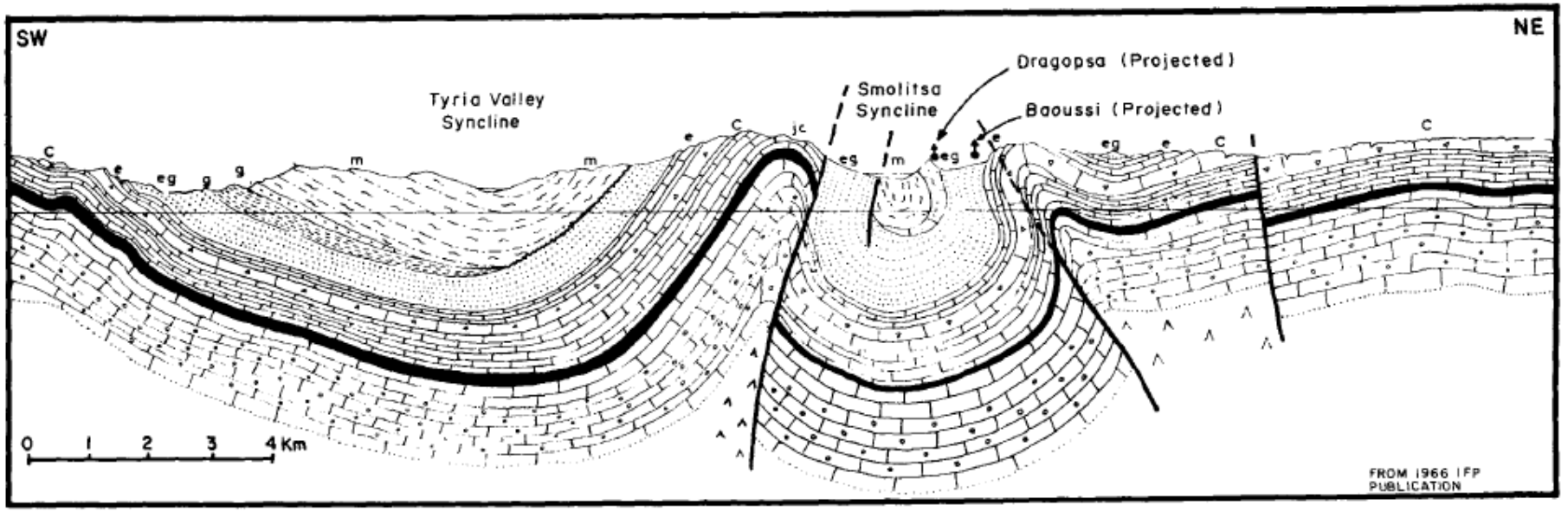
Possible structure with oil seeps in NW Greece



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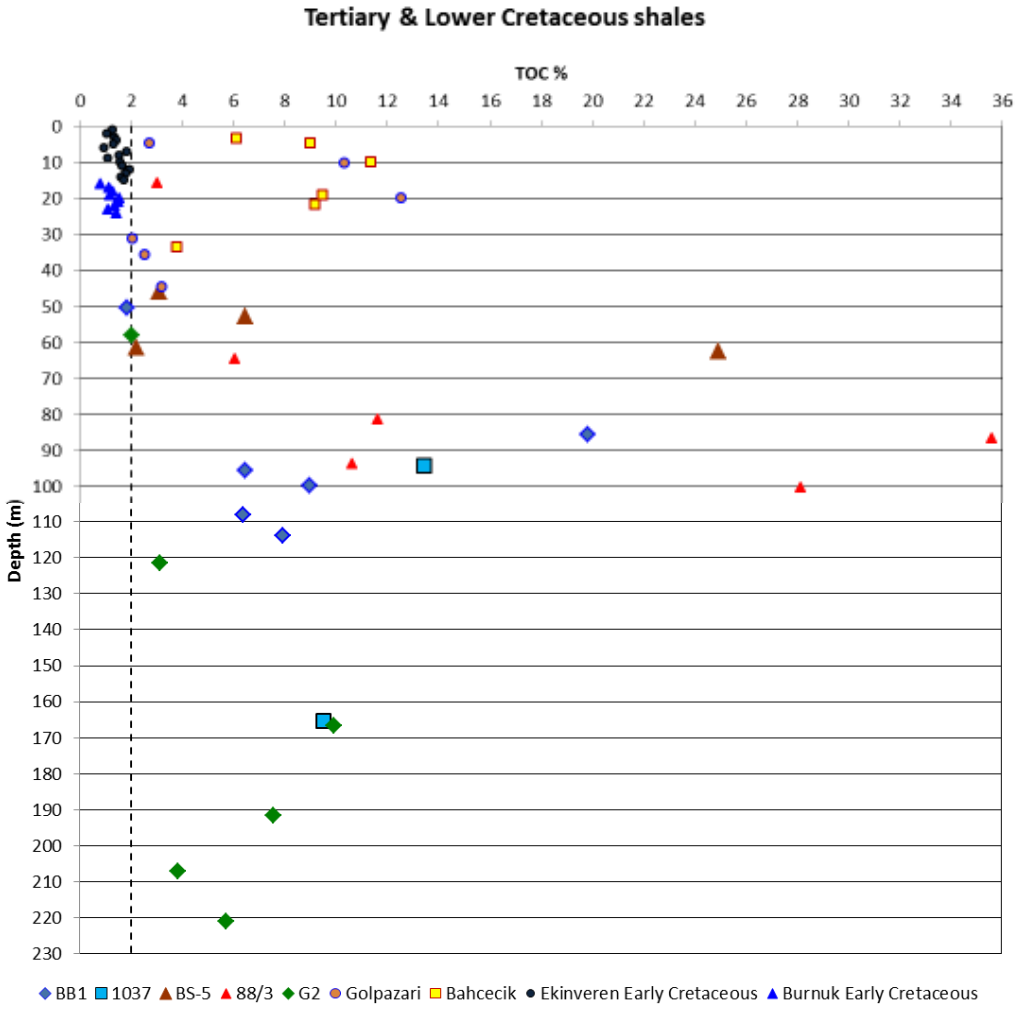
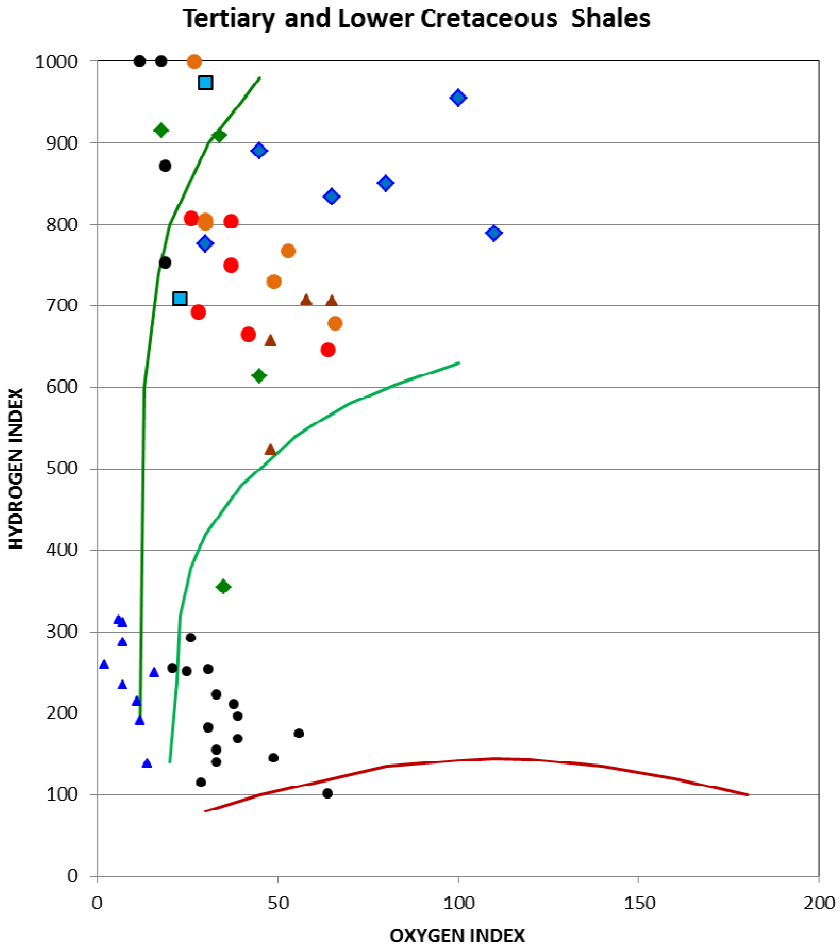
Turkey





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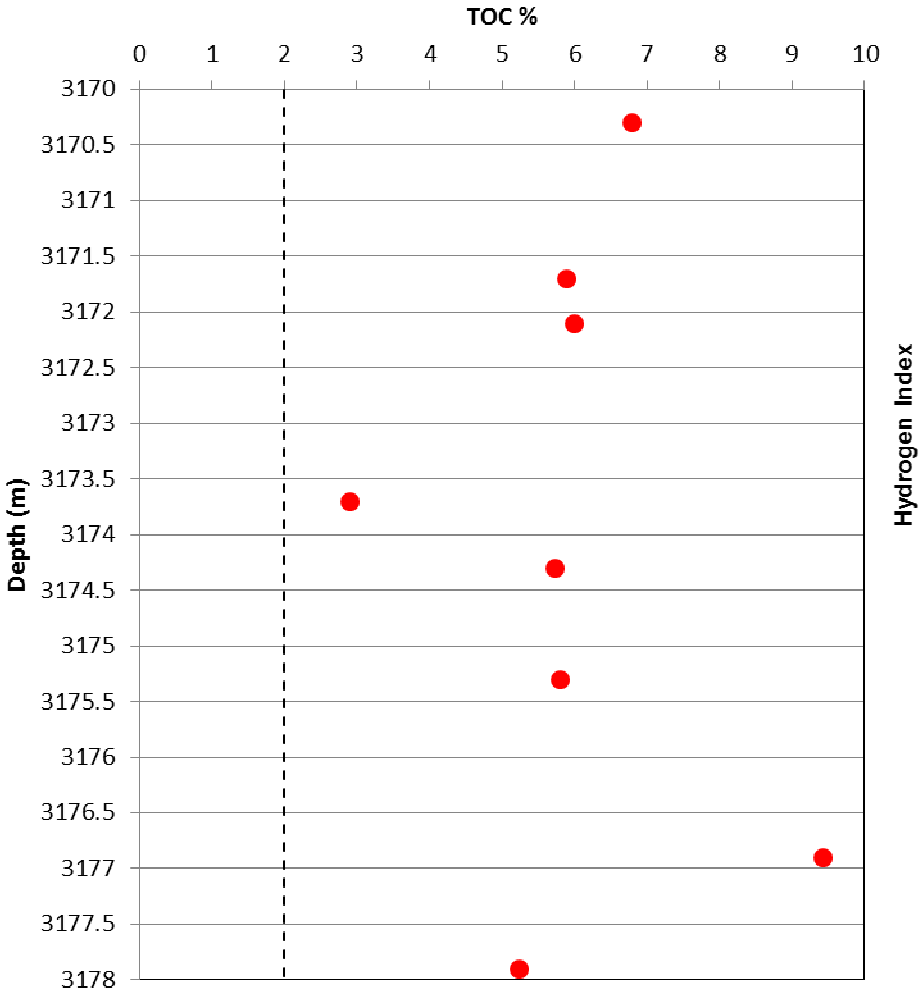
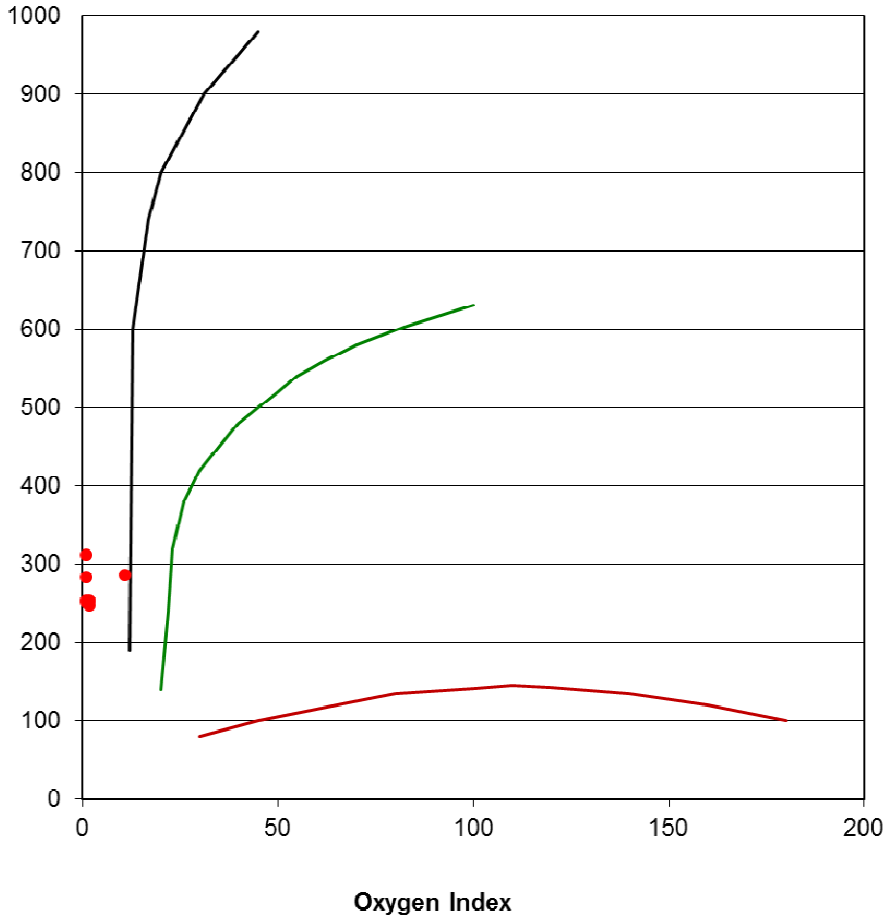
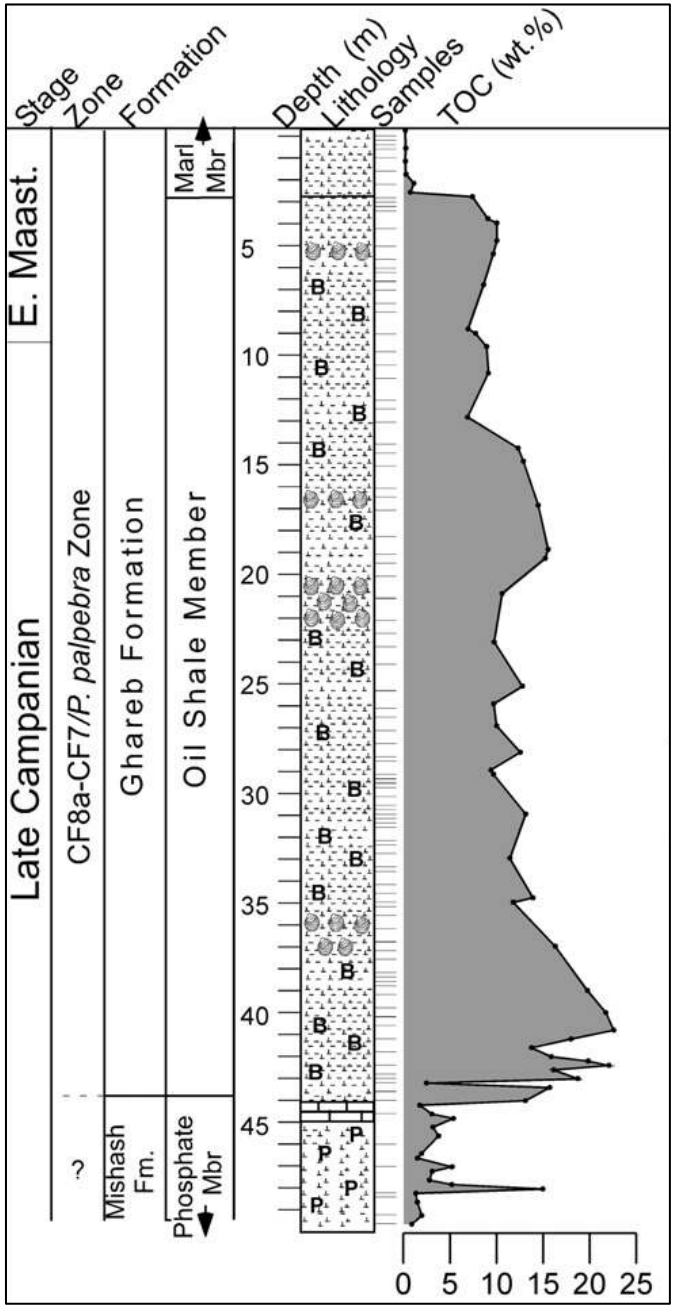
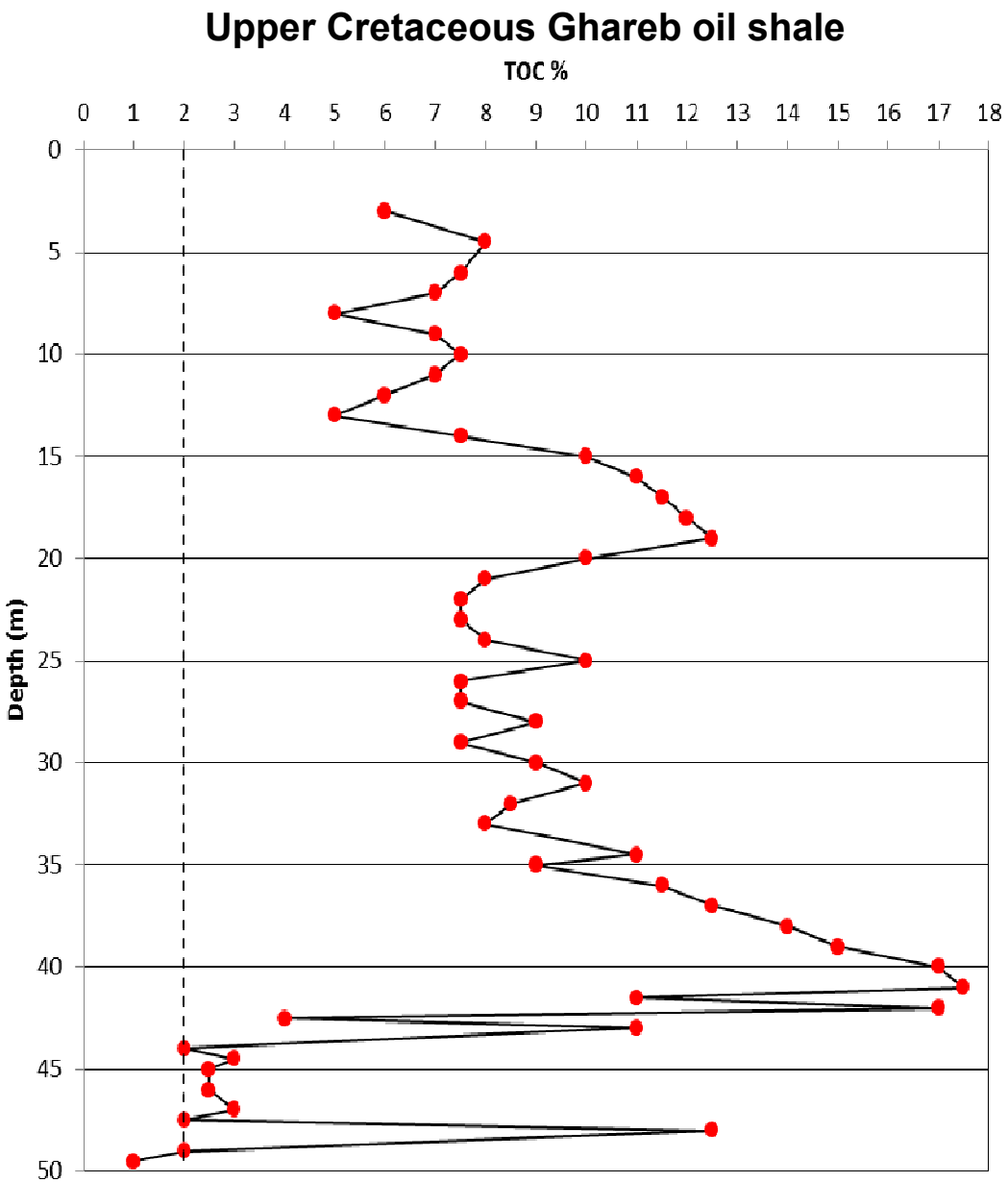
The Silurian Dadaş shale in SE Turkey





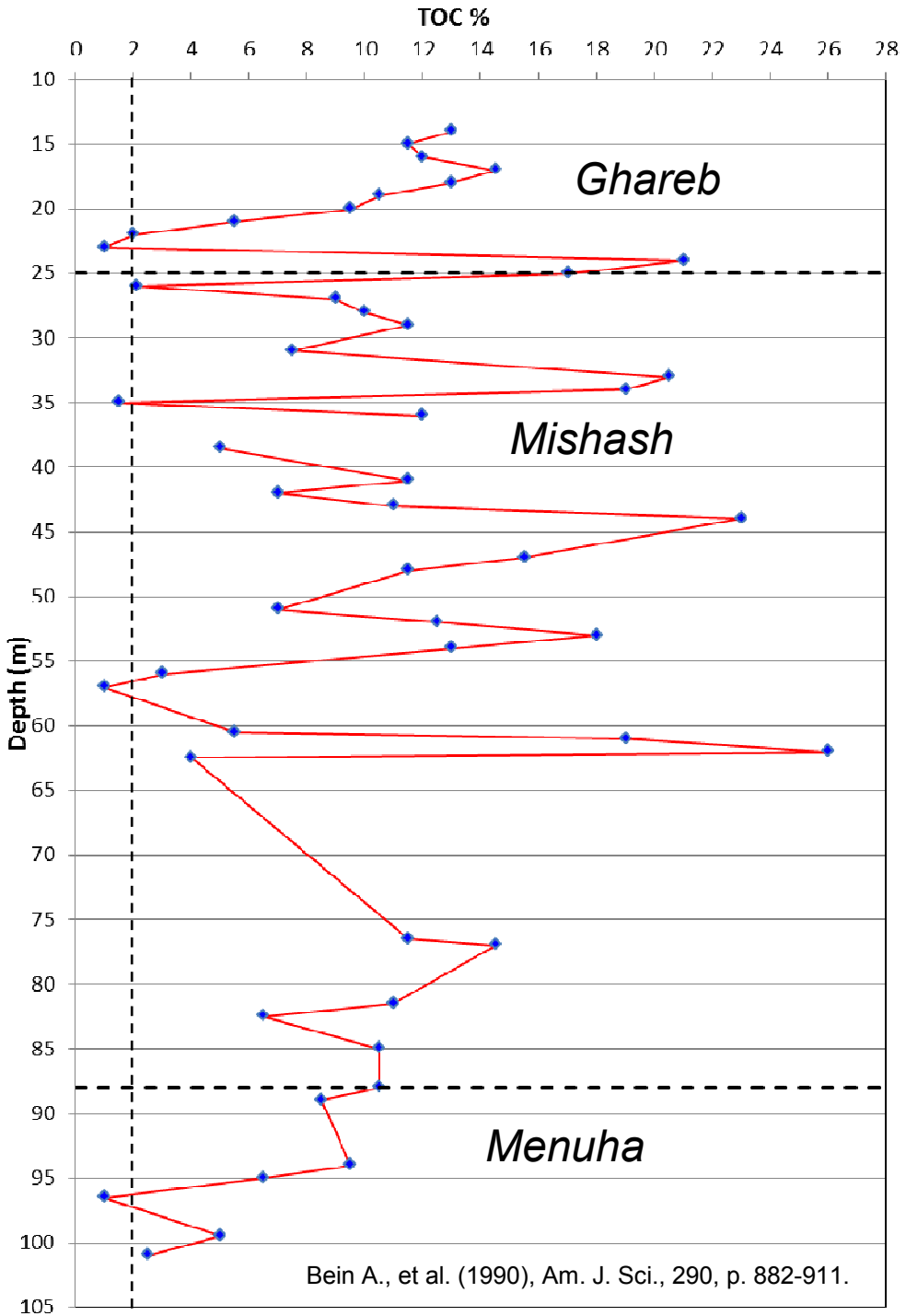

Israel





Schneider-Mor A. (2012), Palaeogeography, Palaeoclimatology, Palaeoecology 319-320, p. 46–57

Marl chalk | Bituminous (oil shale) | Condensed carbonate | Phosphorite | Shell bed (mostly *Inoceramus*)



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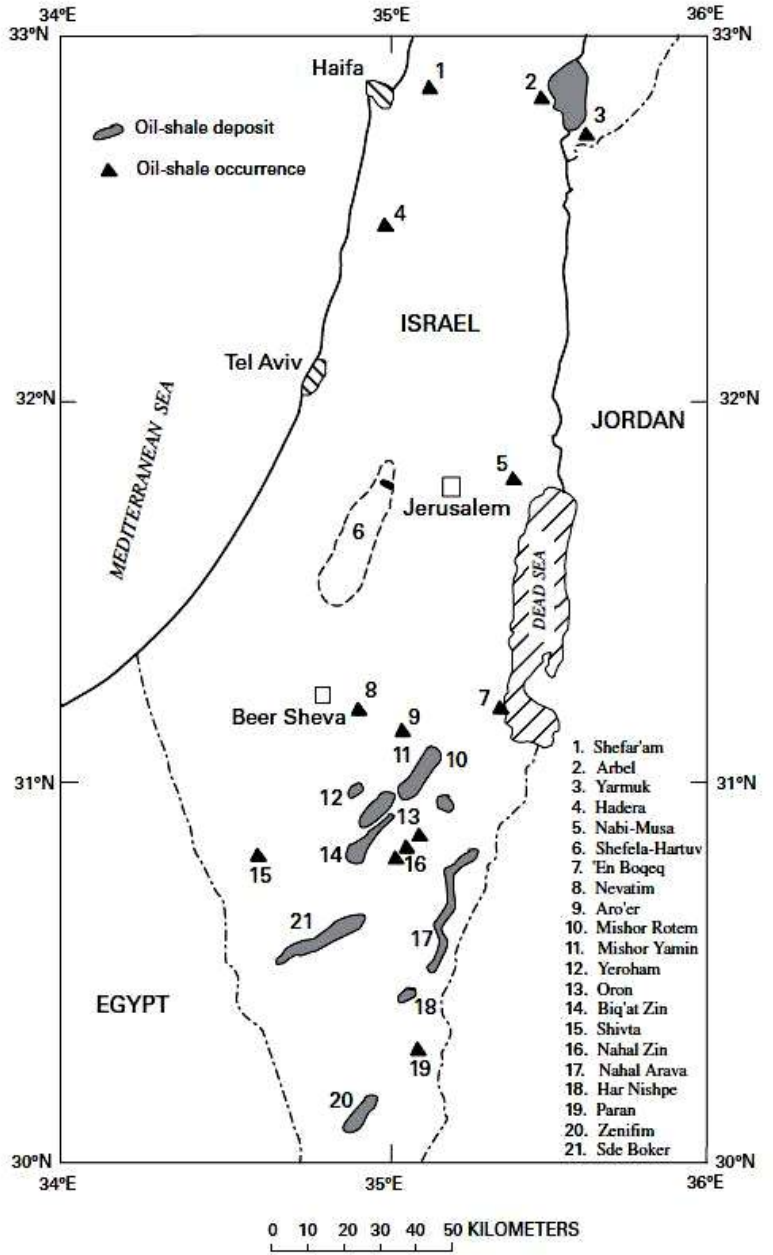

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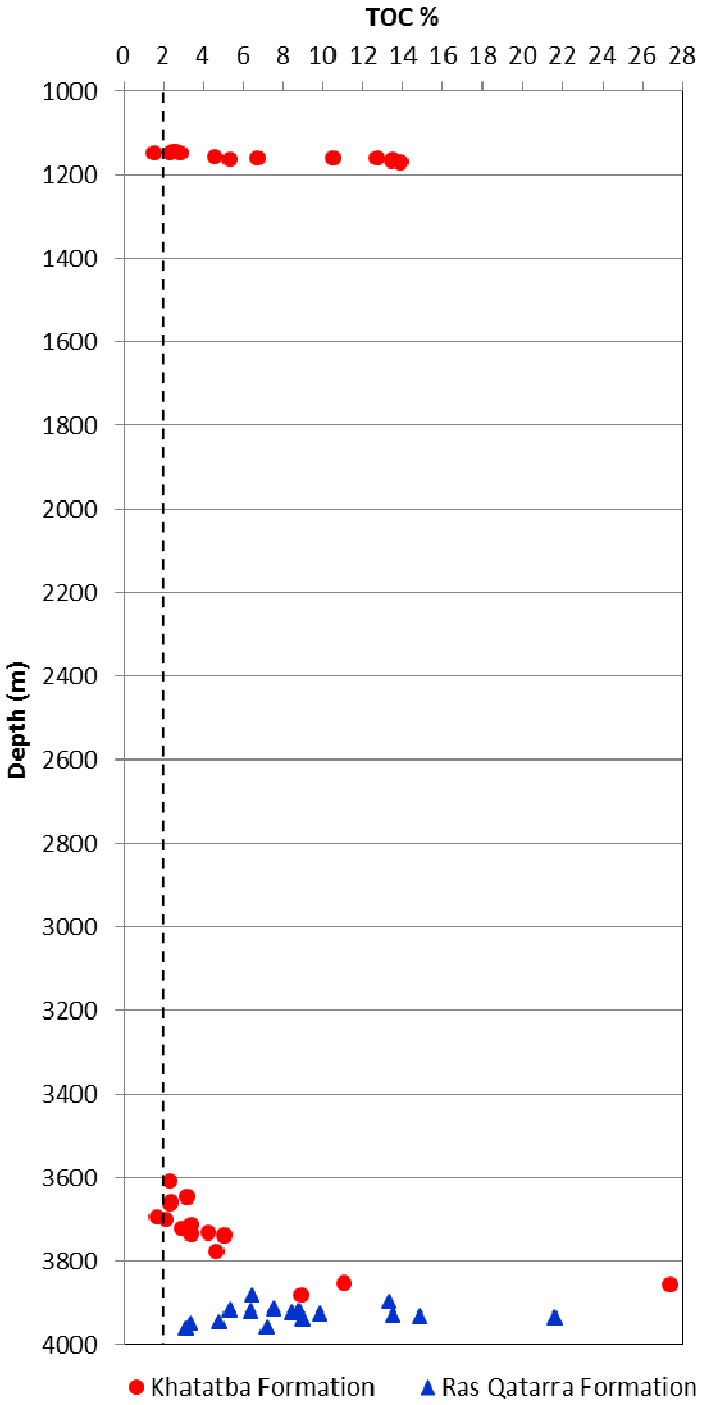
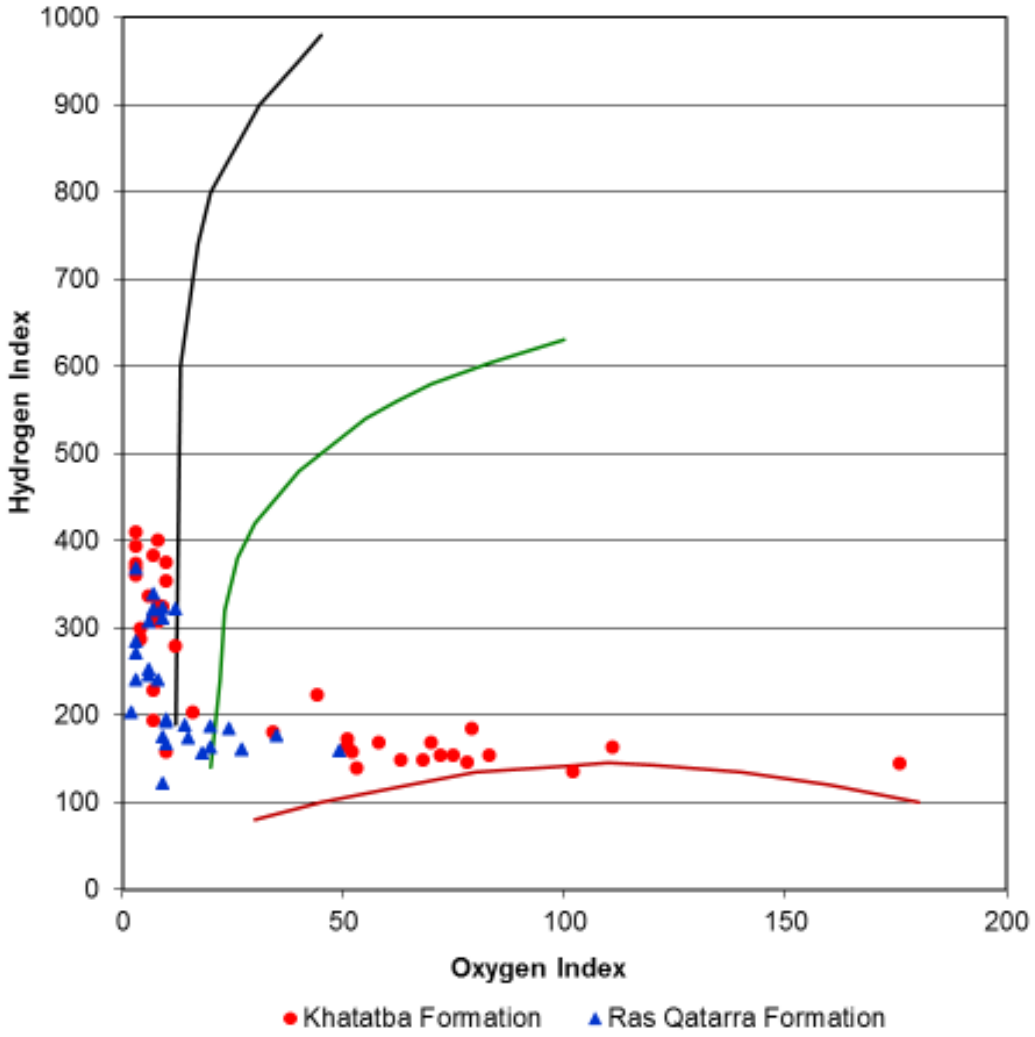
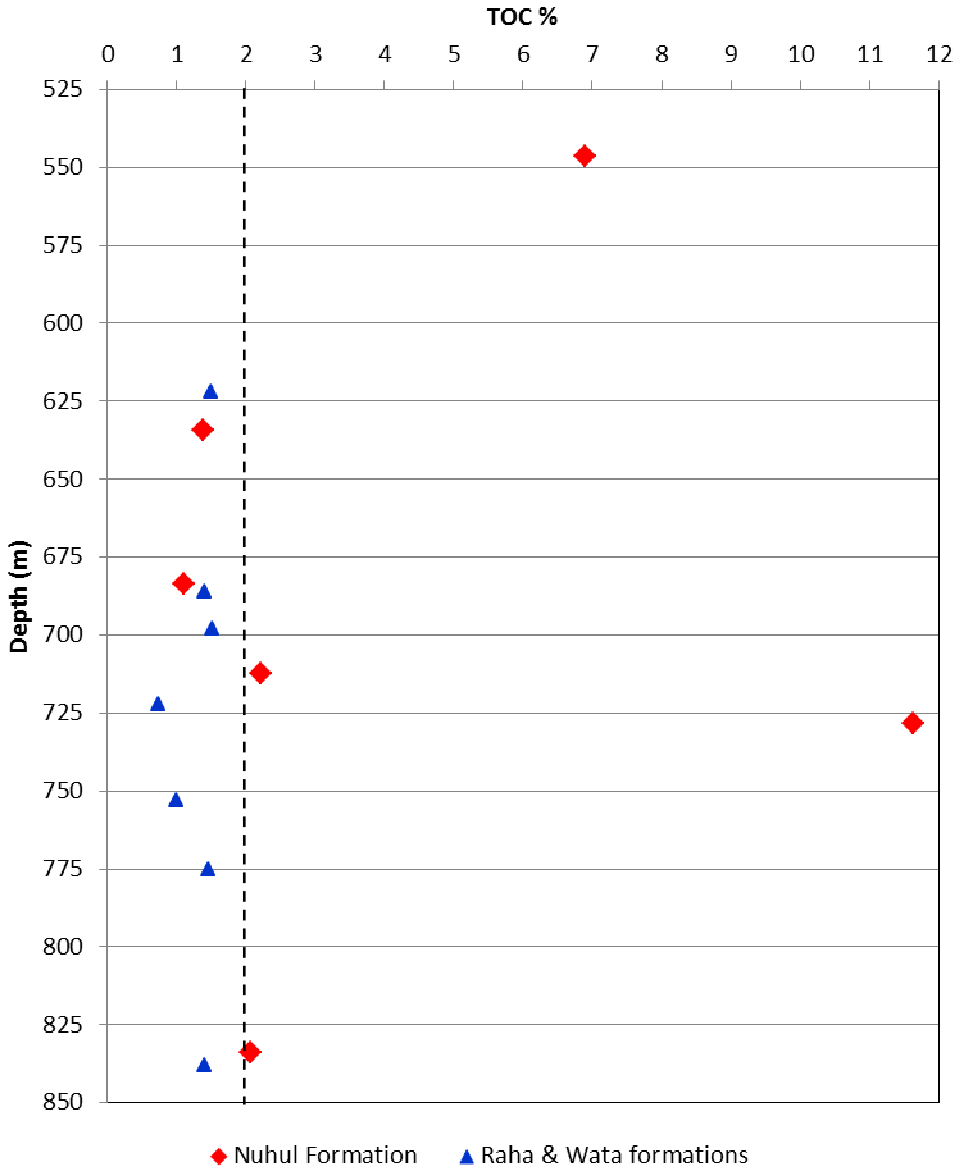
Egypt

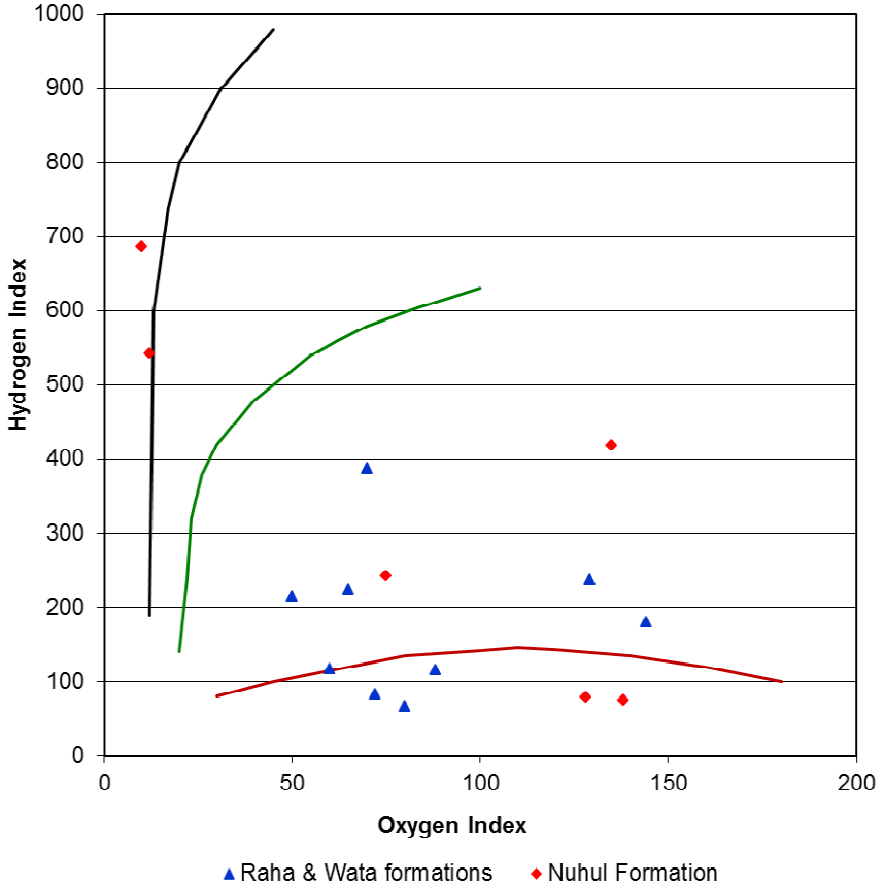
Geochemical properties of the Middle Jurassic *Khatatba* and the Lower Jurassic *Ras Qatarra* shales







Geochemical properties of the Cretaceous Raha & Wate shales and the Miocene Nuhul shales



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Libya

POSSIBLE SHALE TARGETS IN LIBYA

- Triassic lacustrine shales occurring locally in the Sirt Basin.
- Early Cretaceous lacustrine source rocks in the southeastern portion of the Sirt Basin, Libya), explaining the waxy nature of the oil in many of the fields in Libya
- the Late Cretaceous Cenomanian Turonian 'Sirt Shales' and 'Rakb Shales' of the Sirt Basin

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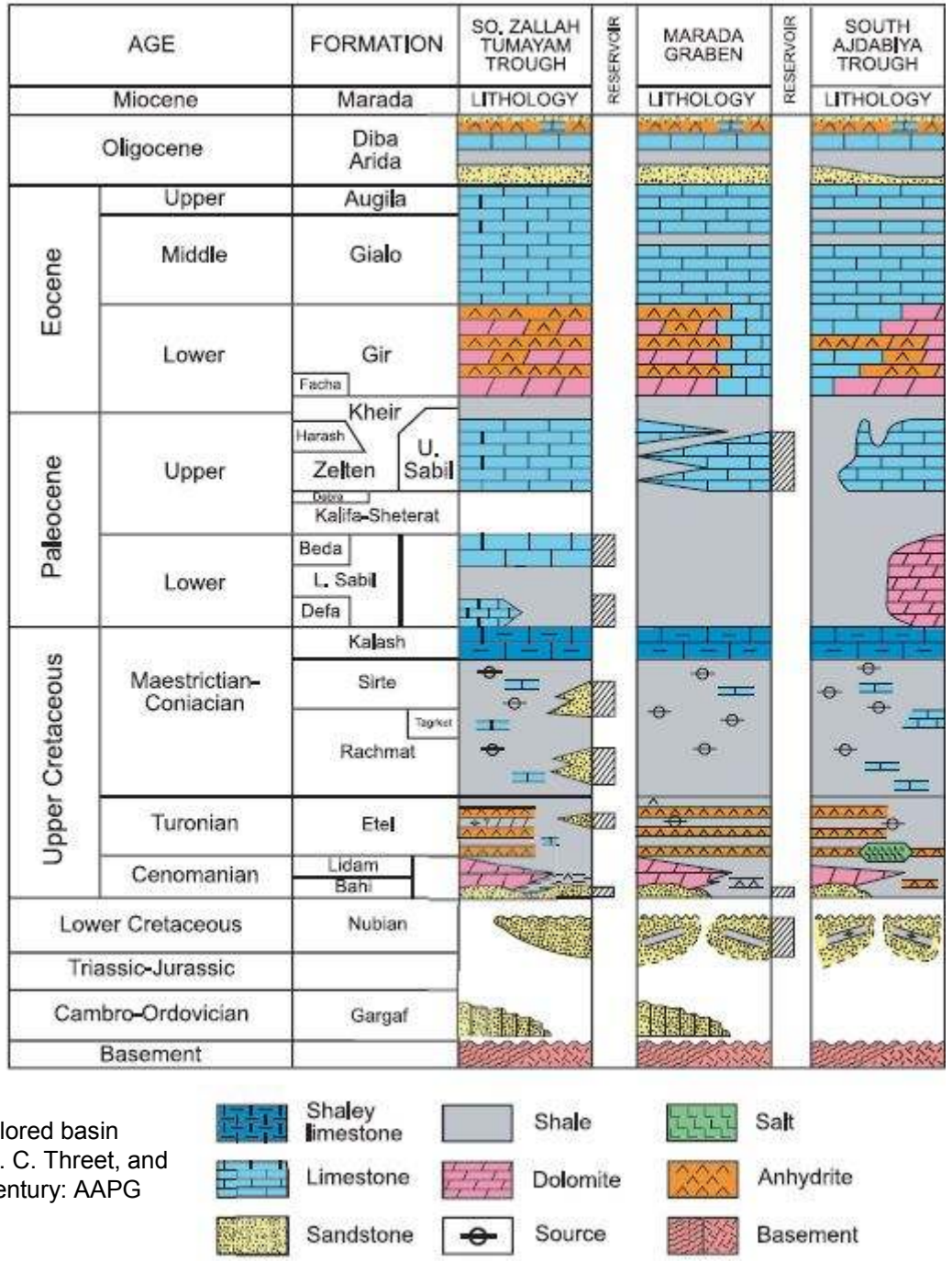

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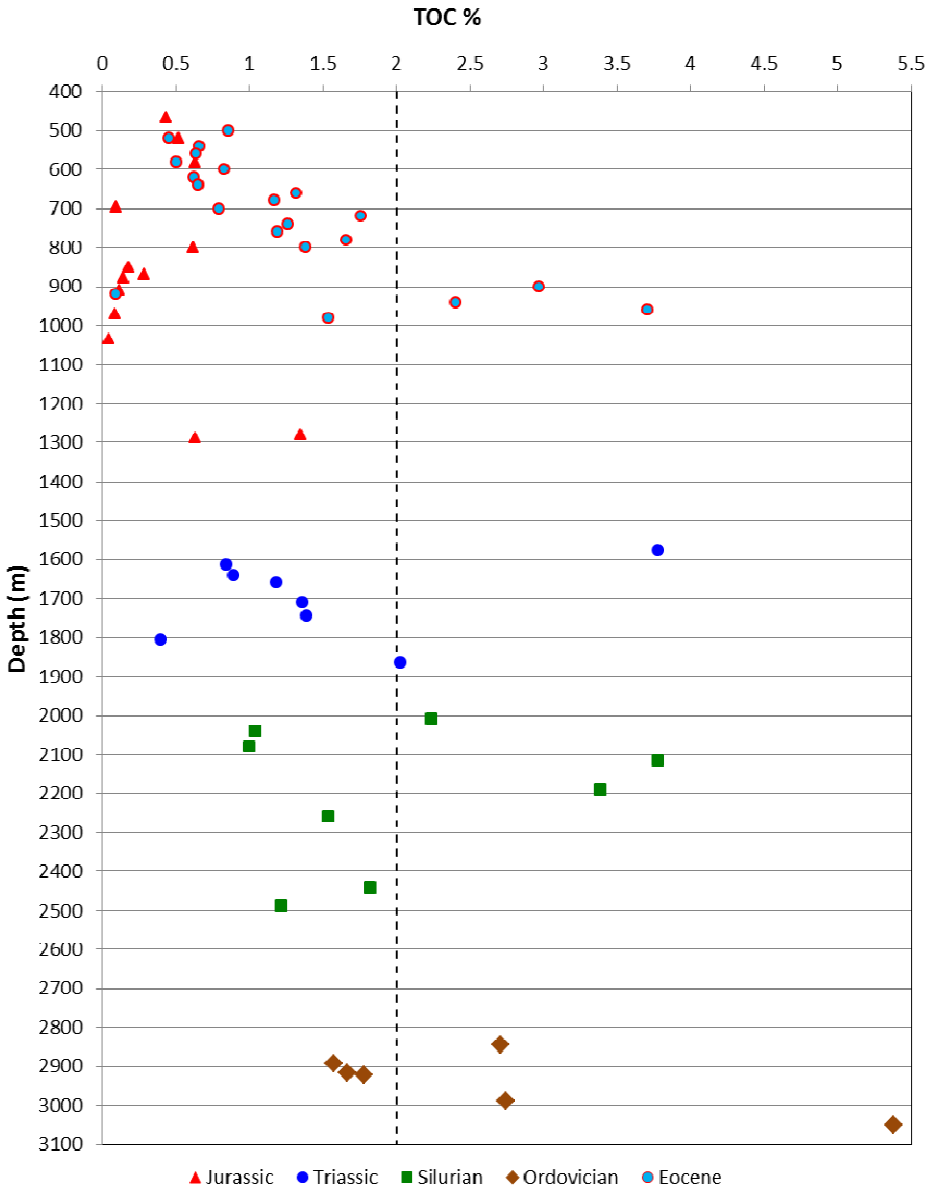
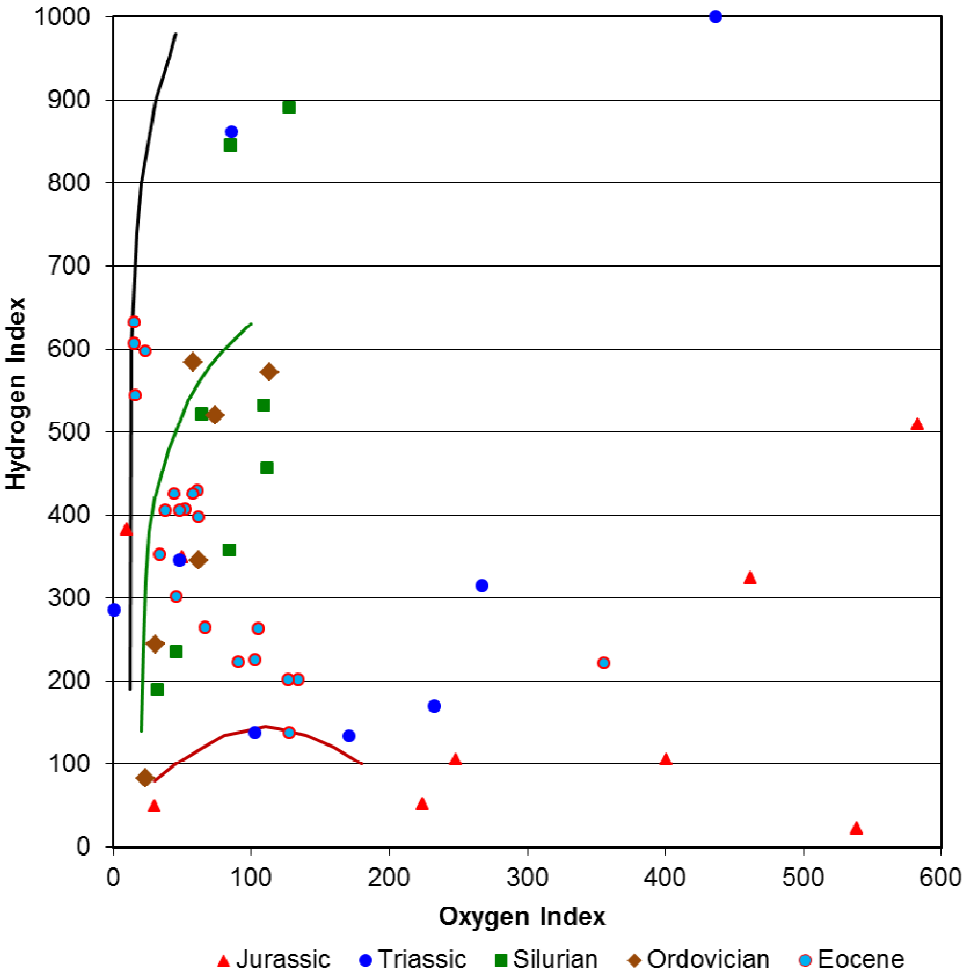
Tunisia

Geochemistry of possible shale targets onshore Tunisia





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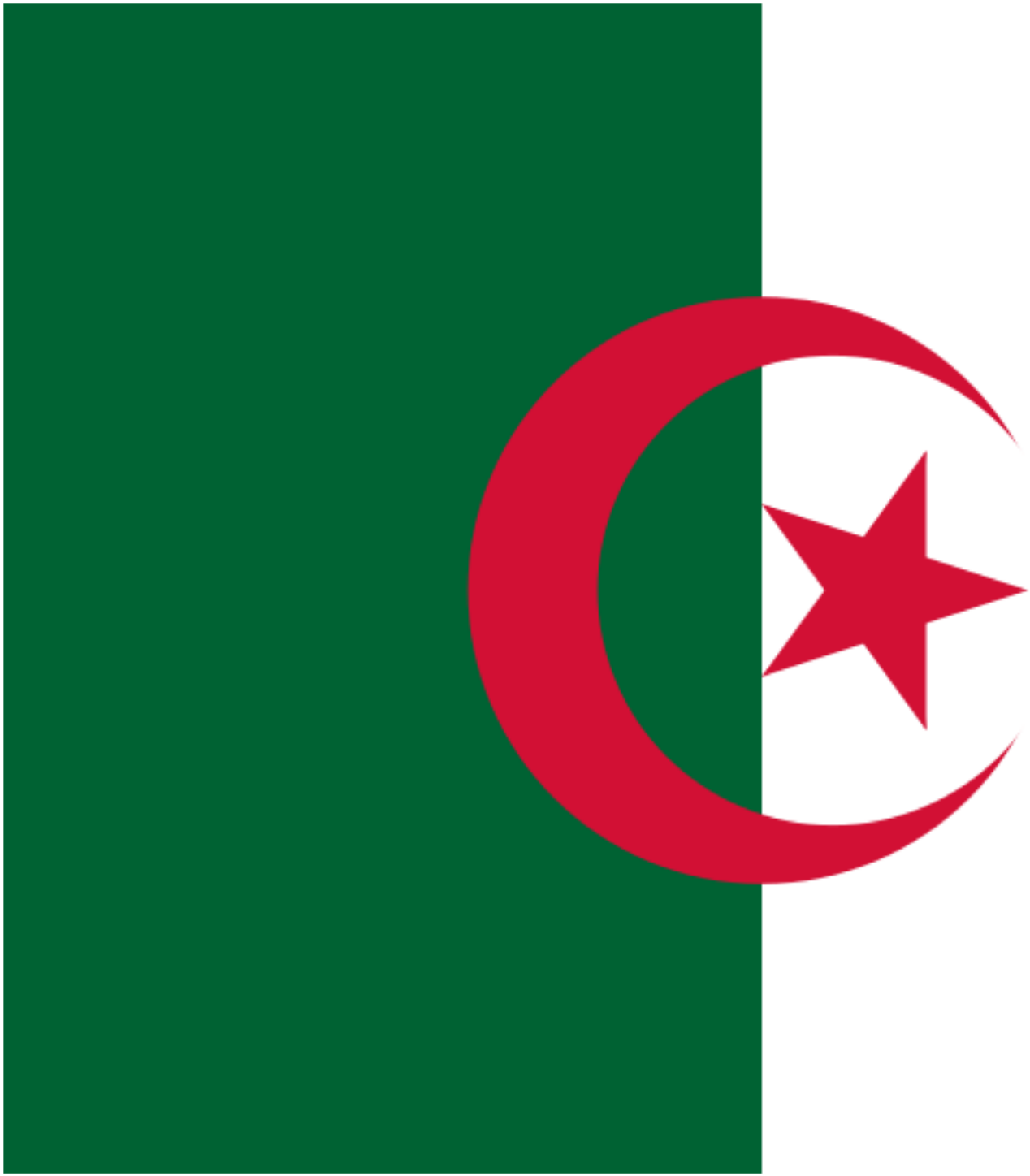
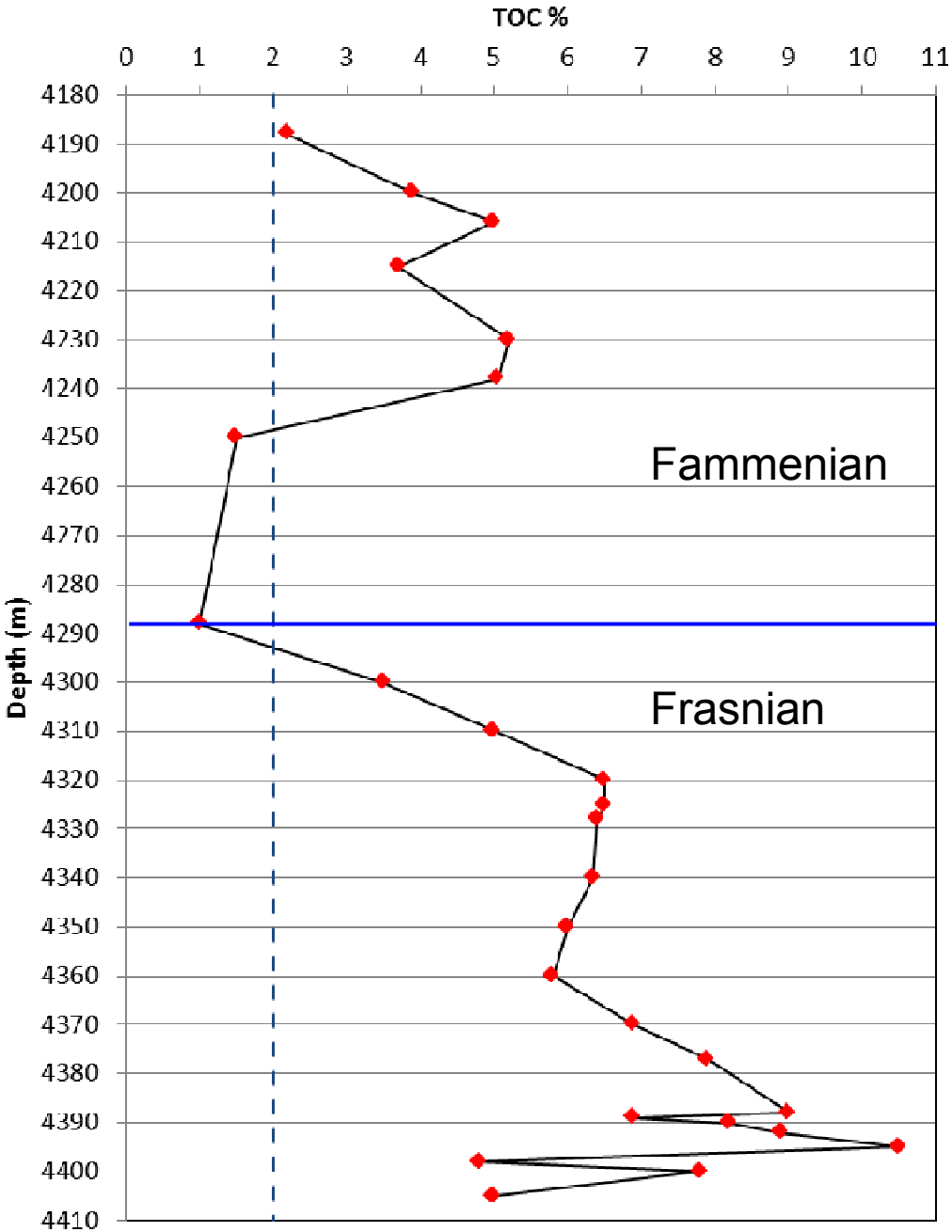


Algeria



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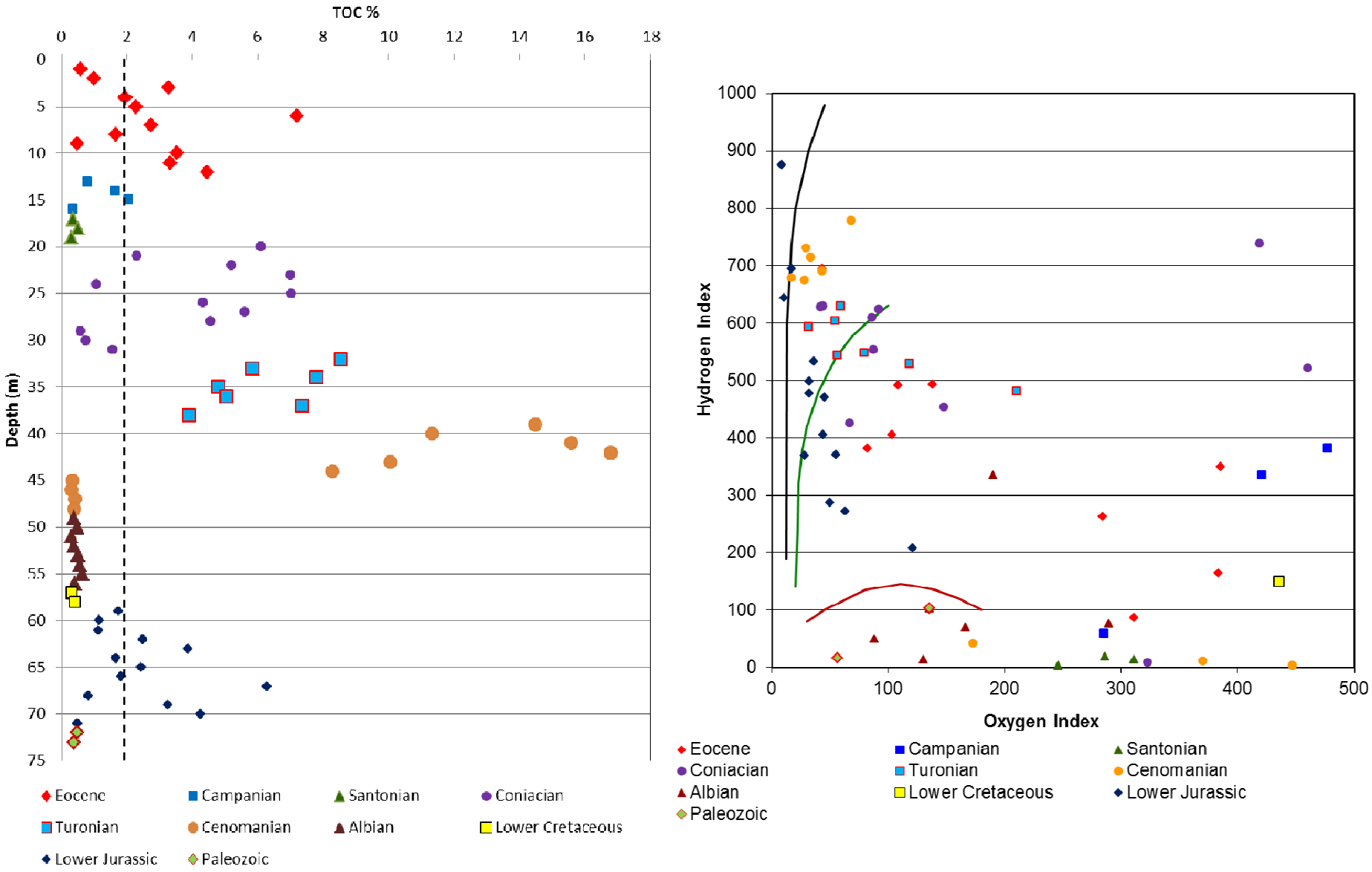
Morocco



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Conclusions

- The onshore basins around the Mediterranean Sea contain several shale formations that could be exploited for unconventional oil & gas.
- Environmental and public opinion/political considerations will determine the future of unconventional petroleum explorations in these basins.