Journal of African Earth Sciences 114 (2016) 1–12

Contents lists available at ScienceDirect

Journal of African Earth Sciences

journal homepage: www.elsevier.com/locate/jafrearsci

Palynofacies and palaeoenvironmental significance of the Albian – Cenomanian succession of the Epunsa-1 well, onshore Tano Basin, western Ghana

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ARTICLE INFO

Article history:
Received 25 June 2014
Received in revised form
26 October 2015
Accepted 28 October 2015
Available online 10 November 2015

Keywords:
Paleoenvironment
Palynofacies
Kerogen
Thermal maturation
Phytoclasts
Palynomorphs
Tano Basin
Ghana

ABSTRACT

Palynofacies analysis carried out on thirty-three (33) cutting samples between the intervals 2990 –5960 ft from the Epunsa-1 well onshore Tano Basin, identified three palynofacies types (P-1 to P-3). Palynofacies 1 (P-1) reflects deposition in shallow marine environment adjacent to active fluvial sources under a mud-dominated oxic (distal shelf) condition, Palynofacies 2 (P-2) was deposited in a shallow marine to fluvio-deltaic environment under a heterolithic oxic shelf condition and Palynofacies 3 (P-3) was deposited in a fluvio-deltaic environment in proximity to the source of vegetation under a dysoxic shelf condition.

Visual kerogen analysis and spore colour for evaluation of hydrocarbon potential and thermal maturation respectively indicate early mature oil/gas prone to immature gas prone source rocks in the studied interval in the Epunsa-1 well.

The presence of *Afropollis, Classopollis*, *Ephedripites*, and elaterate pollen as well as pteridophytic fern spores suggest a paleoenvironment with parent plants inhabiting moist biotopes or wetlands in a humid and warm coastal plain in a semi-arid/arid climate. Biostratigraphically significant elaterate pollen and associated taxa indicate Albian – Cenomanian age for the sediments.

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1. Introduction

The Tano Basin (Fig. 1) is a prolific hydrocarbon province comprising Tano and Cape Three Point sub-basin in Ghana, which is part of the larger Ghana–Cote d'Ivoire basin located in the Gulf of Guinea, West Africa. The basin is located between the mouths of two rivers, Ankobra River to the east and to the west by the Tano River. It is East-West onshore-offshore structural basin (Davies, 1986) occupying an area of about 3000 square kilometers offshore and a narrow onshore segment of the southwestern corner of Ghana. The Tano Basin includes the narrow Mesozoic coastal strip of southwestern Ghana, the continental shelf, and steep submarine Ivory Coast-Ghana ridge which form the continental slope (Mah, 1987). The basin is the eastern extension of the Cote d'Ivoire–Ghana Basin and formed as a result of trans-tensional movement during the opening of the Atlantic Ocean in the Albian. Active rifting and subsidence during this period resulted in the formation of a deep basin. Prevailing conditions at the time were ideal for the deposition of shales. Thick organic rich shale was deposited in the Cenomanian and Turonian. Several river systems contributed significant clastics into the deep basin and led to deposition of large turbidite fan/channel complexes (Adda, 2014).

The exploration and discovery of oil and gas from the Tano Basin has necessitated further drilling thus providing samples for studies focussing on the hydrocarbon potential of the basin, with the Epunsa-1 well (05° 00′ 55′ N, 02° 44′ 0′ E) not being an exception (Fig. 1). The palynofacies and palynological study was done between the intervals 2990–5960 ft.

The objectives of the study is to (1) identify palynofacies types from samples and possible source rock horizon, (2) use spore colouration to evaluate the thermal maturity of the samples, (3) provide insights to the palaeoenvironment of deposition, and (4) to date sediments using spore/pollen.

2. Geologic setting

The Tano Basin formed as a result of a complex series of pull apart and transforms movements which accompanied the opening

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http://dx.doi.org/10.1016/j.jafrearsci.2015.10.020
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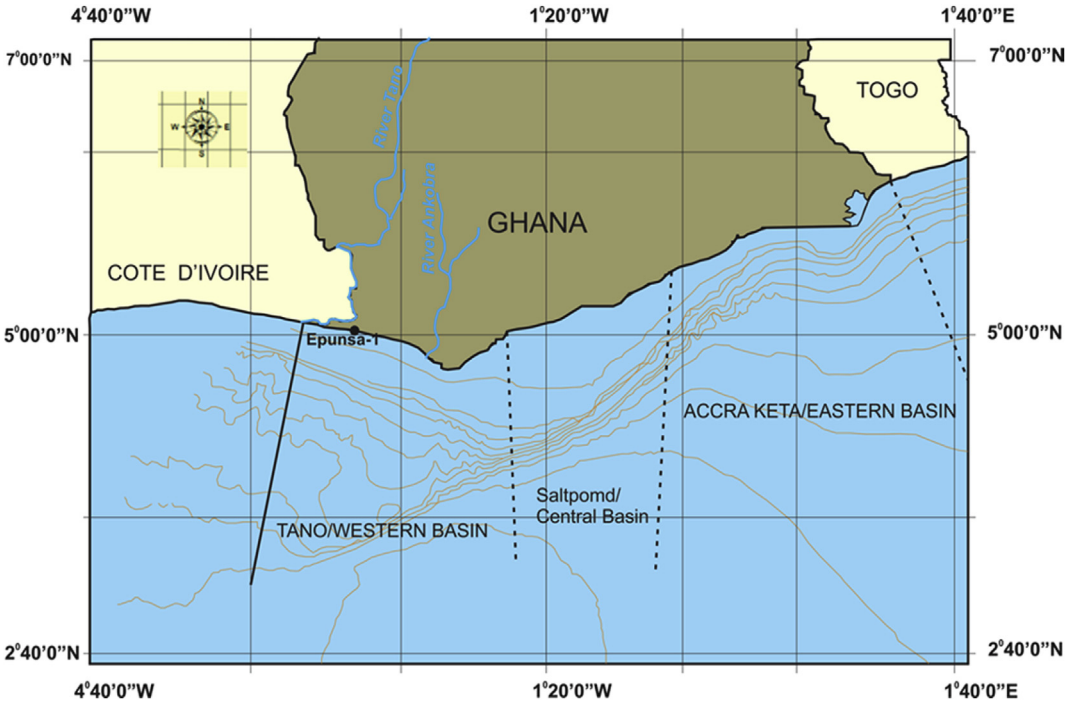

Fig. 1. Map showing the Epunsa-1 well onshore Tano Basin.

up of the South Atlantic Ocean due to the separation of the South American and African continents (Davies, 1986). It forms the eastern extension of the Gulf of Guinea Province which consists of the Cote d'Ivoire, Saltpond and Benin Embayment Basins and several other sub-basins which resulted from Albian trans-tension associated with opening of the Atlantic between the St. Paul to the east and Romanche fracture zones to the western corner (Davies, 1986). The West African Gulf of Guinea has a geological structure associated with the great equatorial fracture system and consists of the eastern flank of the mid-Atlantic Ridge which is offset by a series of parallel to sub parallel fractures.

The Tano Basin is underlain by Cretaceous and Eocene Apollonian sediments and is the focus for deposition of a thick Upper Cretaceous, deep water clastic sequence which, in the Palaeocene – Miocene, provided sufficient thickness to mature an early – mid Cretaceous source rock in the central part of the Tano Basin (GNPC, 2010). This distinct reservoir resulted in the formation of combination trapping geometries that create the Jubilee accumulations, and along which a number of other prospects are located (GNPC, 2010).

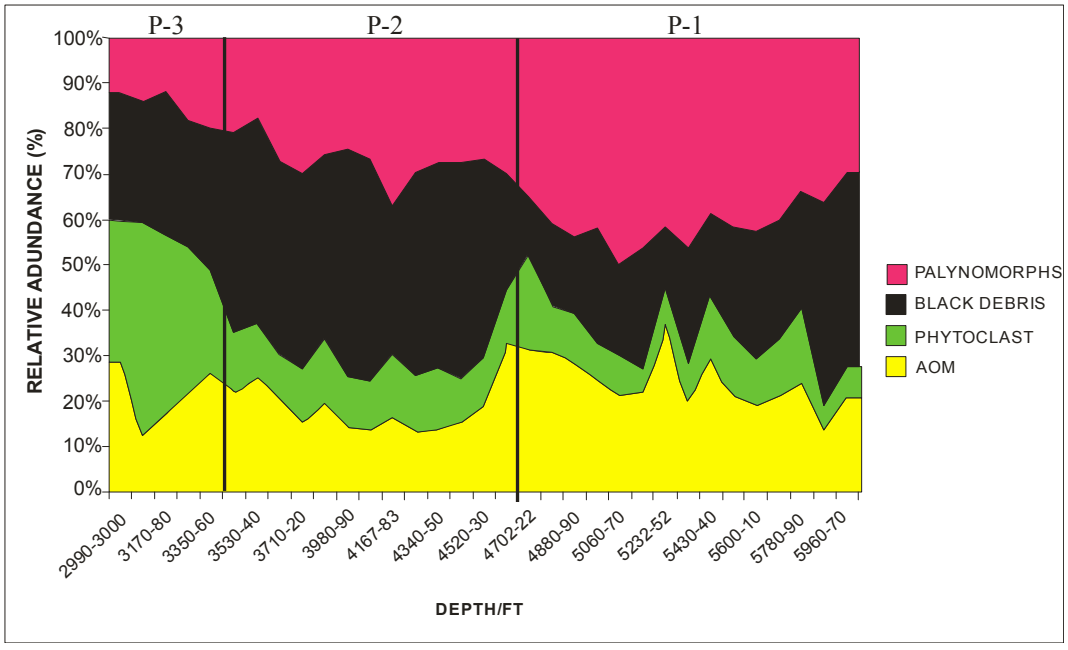

Fig. 2. Relative abundances of palynomorphs, phytoclasts, opaques and AOM within defined palynofacies of the Epunsa-1 well.

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