ID NUMBER: 1996278

Application of Microbiostratigraphy and Gamma-Ray Spectrometry to Correlate Outcrop and Subsurface: Turonian to Paleocene Strata of the Zagros Basin, Lurestan Area

Abstract

Gamma-ray logging of outcrops is a powerful, quick and simple method to better correlate wells data with stratigraphic sections.

Two stratigraphic sections have been measured, sampled and gamma surveyed in Lurestan province, southwest of Iran. The Tang-e Holestem section is located in south flank of Kabir-Kuh anticline and the Chenāreh section is located in south flank of Chenāreh anticline. The rock sequences have been logged by measuring the gamma-radiation every 30 cm. over one minute time. A total of 628 thin-sections prepared and studied for biostratigraphically purposes in order to establish biozones and compare some significant Cretaceous and Paleogene planktonic foraminifer's biozones.

Based on micropaleontological and lithological studies, these stratigraphic sections divided in ascending order from Sarvak to Surgah, Ilam and Gurpi formations (Late Cretaceous (Cenomanian) to Late Paleocene).

The results indicate good conformity between surfaces and adjacent wells log data. It is particularly useful for integrated sequence stratigraphic analysis and for reservoir characterization using outcrop analogues. Because of influence caving and other uncertainty in well studies, these high resolution paleontological and lithological data in surface studies assists in the delimitation of depositional units and can improve our knowledge in wells.

Introduction

Gamma-ray activities are usually measured by scintillometry in well-logging. The natural gamma radiation (GRS) of rocks is the composite of emissions produced by isotopes of Potassium (K), thorium (Th), and uranium (U). For carbonate strata, however, rather few studies documenting spectral GR significance have been published, although there appears to be widespread appreciation that high gamma-radioactivity in carbonates is usually ascribed to uranium of detrital minerals and organic matter, and to thorium and potassium of clays. It is clear that Th and K are linked directly to clay occurrence (Fiet & Gorin, 2000; Raddadi et al., 2005). Instead, there is only a poor correlation between high U contents and clay-rich marly beds, and, some of the uranium peaks is determined by diagenetic processes involving changes in oxidation state (Ehrenberg & Svana, 2001). The relative contributions of these elements to the total gamma ray (GR) log profile of a bore hole can be differentiated by a spectral GR logging tool, and such patterns are commonly examined in hydrocarbon exploration wells as a means of estimating mineralogy, differentiating depositional environments, and recognizing significant stratigraphic surfaces.

In Addition, Gamma-ray logging of outcrops offers a promising technique to directly compare well data with surface geology. It is a quick and simple, yet powerful technique to better correlation. Field gamma-ray spectrometry has the potential to objectively register small lithological changes and significant stratigraphic boundaries, which in outcrop may be difficult to recognize by standard sedimentological logging. Gamma-ray logs are valuable tools for tracing litho-, sequence- and biostratigraphic boundaries (Ruf & Aigner, 2004; Taylor & Sellwood, 2002).

Geologic setting and Methods

The most comprehensive work on the Mesozoic and Cenozoic lithostratigraphic units of the Zagros was carried out by James & Wynd (1965). The pelagic carbonate strata considered in this study belong to the upper Cretaceous to Paleocene succession. These formations have been deposited in the Zagros sedimentary basin, Iran.

The present article reports correlation from two exploration well and two stratigraphical section in the Lurestan province, southwest of Iran (Fig. 1).The Late Cretaceous to Paleocene interval exposed in the study area comprises four lithostratigraphic units (Fig. 2): (1) the Albia to Cenomanian Sarvak Formation, which developed throughout the area and contains sediments that were deposited in a shallow continental to intra-shelf basin environment; (2) the Turonian to Middle Campanian Surgah and Ilam formations, which comprise sediments deposited on isolated platforms that interfingering with basinal environments; (3) the Middle Campanian to Paleocene Gurpi Formation consists of sediments deposited in pelagic to hemipelagic settings. The stratigraphic sections have been measured, sampled and gamma surveyed. The Tang-e Holestem section is located in south flank of Kabir-Kuh anticline and the Chenāreh section is located in south flank of Chenāreh anticline.

We used a hand-held multispectral gamma-ray radiation detection system to investigate the natural radioactivity of the deposits. One-minute counting times were processed every 30 cm, except when the section was missing due to poor exposure.

Samples for micropaleontological studies were taken, every 1.5 meter, and a thin section was made. A total of 628 thin-sections prepared and studied for biostratigraphically purposes in order to establish biozones and compare some significant Cretaceous and Paleogene planktonic foraminifer's biozones (Hemmati-Nasab, 2012; Hosseinzadeh, 2013). To describe the texture of the sediments we use the classification of Dunham (Dunham, 1962).

The gamma-ray logs were calibrated at litho- and biostratigraphic boundaries recognized in two stratigraphic sections and two exploration wells. In this way a framework of time lines was established. The correlations were done by tracing established biozones.

Results and Conclusions

There are some important problems in well cuttings. These problems such as caving and difference between logs and drilling depths can cause uncertainty in biostratigraphy. These problems are not exist in outcrops, so we can have certain information. On the other hand, there are acceptable generally trends for gamma rays and biofacies in outcrops and wells. We can define standard logs for each geological area. This standard logs are useful for correlation and are useful for resolving uncertainties. Hence, Combination of lithological and GRS logging was used to calibrate two stratigraphic sections and two exploration wells.

Correlations and stratigraphic and reservoir quality interpretations of subsurface wireline logs in both oil/gas fields and in exploration areas can be improved by comparing the subsurface logs with outcrop gamma-ray logs of nearby analogous strata.

The results of this study are potentially useful for petroleum exploration in the Lurestan province. Although spectral GR signatures alone would not provide conclusive interpretations of depositional history, this type of evidence could nevertheless be of value to the overall evaluation. This study provides an opportunity to improve correlations through direct comparisons of lithology to well-log patterns.

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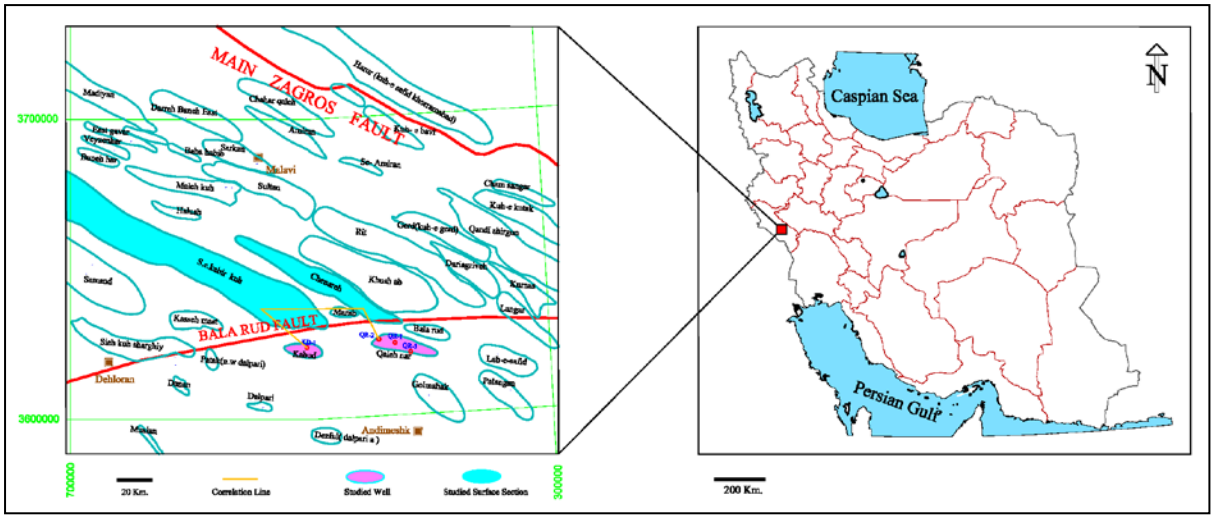

Fig.1) Location map and correlation line of studied outcrops and wells

Fig.2, 3 & 4) Sampling in Tange-Poshteh near K-Pg boundary

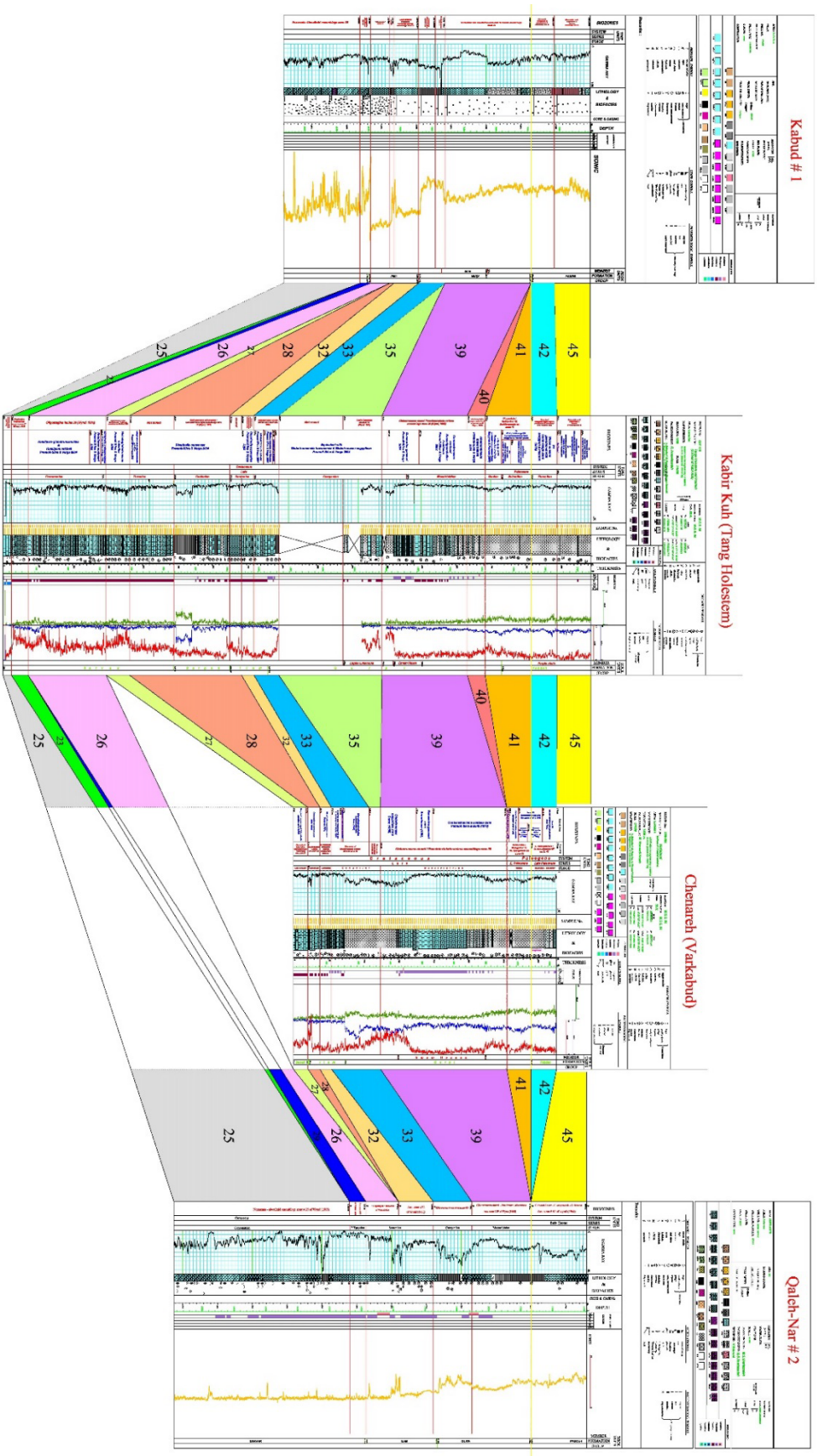

Fig.5) Correlation chart of studied outcrops and wells