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Research Paper

ROLE OF FORAMINIFERA IN HYDROCARBON EXPLORATION

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The paper aim to review the applied role of foraminifera in hydrocarbon exploration and its applied usefulness, and the oil industry. This paper was written in an attempt to provide an overview of the role of foramnifera in the hydrocarbon exploration and their usefulness in biostratigraphy and palaeoenvironmental interpretation.

Keywords: Foraminifera, Hydrocarbon, Oil Industry, Exploration

INTRODUCTION

The aim of this chapter is to review the applied role of foraminifera in hydrocarbon exploration. The science of micropalaeontology has historically been supported and driven during its development because of its applied usefulness, and the oil industry continues to provide employment for many micropalaeontologists for this reason. This paper was written in an attempt to provide an overview of the principles involved in the application of the science. The term micropalaeontology is used in its broad sense to include the study of all microfossil groups of plant affinity (e.g., spores, pollen, dinoflagellate cysts, diatoms) or animal affinity (e.g., radiolaria, foraminifera). The particular advantages of using microfossils for subsurface biostratigraphy are: a) Microfossils are small size that enables them to survive destruction by standard drill bits. As the bulk of samples comprise accumulations of rock fragments derived by fracturing of rocks by drill bits, most macrofossils are destroyed by the drilling process. (b) abundance: Microfossils can achieve astonishing abundance, some samples comprising almost 100% fossil oozes. In these cases the microfossils can be of rock forming density. In such occurrences, several thousands of specimens can occur in a 10 ml volume sample. In an equivalent sample one would be fortunate to find a single fragment of a macrofossil.

ROLE OF MICROFOSSIL IN HYDROCARBON EXPLORATION

Ooze

It is pelagic deep-sea sediment of which atleast 30% is composed of the skeletal remains of microscopic floating organisms. Deposits of soft mud on the ocean floor. 1/3 Earth's Surface is

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Covered by this Ooze as a Raw Material for Hydrocarbon. Oozes are divided into: (i) Calcareous oozes, (ii) Siliceous oozes. Calcareous ooze: it includes (a) Globigerina ooze: containing the shells of planktonic foraminifera (b) Pteropod ooze: made up chiefly of the shells of pelagic mollusks. Siliceous ooze: (a) radiolarian ooze, (b) Diatom ooze Globigerina ooze is the most widespread of the oozes and occurs in both the Atlantic and Indian oceans.

Microfossils have many applications towards hydrocarbon exploration. There are a great number of different types of microfossils available for use. There are three groups which are of particular importance to hydrocarbon exploration. Three microfossils which are of particular importance to hydrocarbon exploration are: Foraminifera, Calcareous Nannofossils and Palynomorphs. A brief introduction of these group is given below:

FORAMINIFERA

Foraminifera have many uses in hydrocarbon exploration and are used to interpret the ages and paleoenvironments of sedimentary strata in oil wells. Agglutinated fossil Foraminifera buried deeply in sedimentary basins can be used to estimate thermal maturity, which is a key factor for hydrocarbon generation.

Calcareous Nannofossils

These are extremely small objects (less than 25 microns) produced by planktonic unicellular algae Coccolithophores, planktonic golden brown algae that are very abundant in the world's oceans. The calcareous plates accumulate on the ocean floor, become buried beneath later layers, and are preserved as Nannofossils.

PALYNOMORPHS

Spores and Pollens are transported by wind and water and can travel long distances before final deposition. Organic chemicals comprising Palynomorphs get darker with increased heat. Helps to assess the temperature to which a rock sequence was heated during burial and thus it is useful in predicting whether oil or gas may have formed in the area under study.

Applications of Foraminifera in Hydrocarbon Exploration

Foraminifera are protists that make a shell (called a "test") by secreting calcium carbonate or gluing together grains of sand or silt. Most species of "forams" are bottom- dwellers (benthic), but during the Mesozoic Era a group of planktonic foraminifera arose. These forms were free-floating in the oceans and as a result are more widely dispersed than benthic species. After death, the planktonic foraminifera settle to the bottom and can be fossilized in the same rocks as contemporaneous benthic species. Benthic foraminifera tend to be restricted to particular environments and as such provide information to the paleontologist about what the environment was like where the rock containing the fossils formed. For example, certain species of foraminifera prefer the turbid waters near the mouths of rivers while others live only in areas of very clear water. Planktonic foraminifera provide less information concerning the environment of deposition, since they lived floating in the water column; but they have other advantages. Whereas benthic foraminifera are restricted to certain environments, planktonic foraminifera are dispersed over a much broader part of the world oceans and often are found in large numbers. Foraminifera have many applications to petroleum geology. The two most common uses are: biostratigraphy and paleoenvironmental analyses.

Biostratigraphy is the differentiation of rock units based upon the fossils which they contain. Recognition of unconformity in the subsurface is being done by biostratigraphic methods, viz., absence of biozone(s). Through biostratigraphy the hiatuses in geological history are being estimated routinely by many micropaleontologists. The fundamental principal in stratigraphy is that the sedimentary rocks in the Earth's surface accumulated in layers; with the oldest on the bottom and the youngest on the top. The different fossils in a predictable sequence below the point in time where the organism became extinct. In our simplified case, the extant species C is present in the uppermost layers. Species B is only found in lower layers. The well does not penetrate any layers containing fossil A. The point at which you last find a particular fossil is called its Last Appearance Datum (LAD). In a simplified case, the LAD in one sequence of rock represents the same geologic moment as the LAD in another sequence.

Paleoenvironmental analysis is the interpretation of the depositional environment in which the rock unit formed, based upon the fossils found within the unit. Most of the microfauna can be of great help in visualising the environment (Provenance)at the time of their deposition. Examples are: 1. Lacustrine environment: diatoms, sponge spicules and also rare occurrence of foraminifera. 2. Littoral environment: we encounter sessile foraminifera and ostracods. 3. Lagoonal environment: spores and pollens, conodonts, arenaceous and porcelaneous foraminifera. Through paleoenvironmental analysis the fluctuation in sea level can be reconstructed by initially inferring the paleobathymetry and then integrating the same on a regional scale using seismic stratigraphy for reconstruction of transgressive/regressive cycles within a time frame. Once this exercise is completed, based new techniques that have emerged over two decades the depositional sequences can be inferred. The sequences thus identified, depending on whether they form part of transgression, regression or a high stand of sea can be used for depositional models for a successful exploration campaign.

CONCLUSION

In hydrocarbonexploration the biggest help through micropaleontology is to determine the precise age in outcrop or in the drilling well or to determine the correct stratigraphic position with the help of microfossils. Scope of micropaleontology in the interpretation of paleo-water depth and paleoecology are also vital points to develop geological depositional models.

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