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CALCULATION OF INITIAL TOC USING OIL GENERATION MODELING IN DEZFUL EMBAYMENT, ZAGROS,IRAN

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ABSTRACT

Source rock evaluation in Dezful Embayment from well log indicated Pabdeh and Gurpi F.ms has been matured in some oilfields and parts of the other oilfields, therefore we must calculate initial TOC, for this purpose transformation ratio (TR) can be used. We used Ro/TR diagram (Bordenve 1993) for estimating of TR, and oil generation modeling for E.Ro (equal Ro). Consequently, we could calculate initial TOC % and plot ISO TOC contour   map in this area.

 The study shows:

1- Transformation ratio (TR) of the Pabdeh formation varies from 23% in Aghajari to 75% in Palangan oilfield.

2- Average initial TOC % in the Pabdeh formation is about 1.1-3% and in Gurpi formation is 0.5-1.9%.

INTRODUCTION

Total organic carbon (TOC %) is one of the important parameters that must be estimated for source rock evaluation. Amount of TOC can be measured by Rock eval, or calculated from well logs. This technique uses overlaying of porosity log (sonic, density and neutron) and resistivity log for calculating of TOC%. But for study of TOC % variation in an area source rock may has matured in some fields or parts, so a fraction of source rock's organic matter convert to oil and gas, consequently TOC % in these places become lower than other places, in these cases it is necessary to calculate initial TOC. For this purpose estimating of transformation ratio (TR) is very useful.

In sedimentary basins temperature increase due to burial of the sediments results in a transformation or cooking of the sedimentary organic matter of which petroleum is a by product. This transformation was found to be kinetically controlled, i.e. it depends on time and temperature (Bordenave 1993).

Transformation ratio (TR):

Transformation ratio (TR) is ratio of generated petroleum to potential petroleum. In other words it is ratio of organic matter which is transformed to oil and gas. TR is calculated only in the kerogen bearing cells(source rock cells). TR is calculated from the kinetic reaction of petroleum formation.

STUDIED AREA:

The Dezful Embayment is most important hydrocarbon provinces in Iran ,its located south of Iran with 50000 sq km, produces from the Asmari limestone of Early Miocene and from the Cenomanian Sarvak limestone, and contains some 400 billion barrels of oil-in-place, or 7% of the oil global reserves .Three source rocks are associated with these reservoirs, the Kazhdumi Fm of Albian, Gurpi F.m of Upper Cretaceous and the Middle Eocene Pabdeh Fm.

RESULTS AND DISCUSSIONS

Forty two wells located at the northern part of the Dezful Embayment are considered in this study. A well log analysis based on resistivity and sonic logs is carried out. Total organic carbon (TOC %) of source rocks in all wells was calculated. Results indicated that Gurpi and Pabdeh F.ms TOC% in some wells are decreased considerably, because geothermal gradient of these wells are higher than other wells, high geothermal gradient caused to maturation of these formations, so a fraction of their TOC has converted to oil. Also Gurpi and Pabdeh F.ms have been matured in north of northern Dezful Embayment according to geochemical investigation (Bordenave and Burwood 1990) and oil generation modeling. Thus for comparison we need to calculate initial TOC%. For this purpose we used transformation ratio (TR).The transformation ratio is related to organic matter maturation, the more maturity is increased, the more oil is generated. One of the maturation indicator is vitrinite reflectance, in general oil generation occurrence between 0.6 -1.3 %Ro (vitrinite reflectance). Therefore transformation ratio is related to the vitrinite reflectance. Burhum and Sweny (1990) presented a mathematical method for calculation of vitrinite reflectance that called Easy Ro (E.Ro). The oil generation modeling software uses this method for prediction of maturity vs. depth. With respect to good correlation between P.B.M software predictions to measured vitinite reflectance in our area, it used equal Ro. Bordenave (1993) presented a diagram between TR and Ro (FIG.1). Since according to geochemical studies kerogen type II is dominate in Dezful Embayment we digitized only related diagram (table 1).
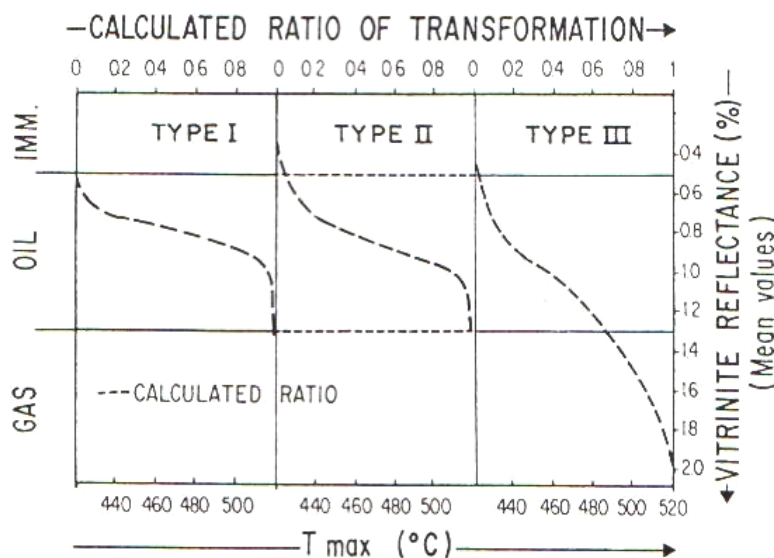
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FiG1: Transformation ratio for différent types of kerogen (Bordenve 1993)

Table 1-digtized quantities

of Ro/TR diagram

Ro	TR
0.1	0.003071
0.009372	0.003071
0.05229	0.003071
0.106699	0.003071
0.164734	0.006699
0.197379	0.006699
0.230024	0.013953
0.288059	0.021207
0.331586	0.035716
0.37874	0.053852
0.433148	0.071989
0.46942	0.090125
0.5	0.111888
0.549219	0.140906
0.592746	0.169923
0.636272	0.217077
0.672544	0.275113
0.701562	0.333148
0.719698	0.373048
0.737834	0.40932
0.759597	0.456473
0.784988	0.507254
0.803124	0.554408
0.817633	0.59068
0.832142	0.623325
0.843023	0.648716
0.86116	0.684988
0.868414	0.717633
0.88655	0.76116
0.901059	0.801059
0.919195	0.840958
0.944586	0.880858
0.966349	0.909875
0.998994	0.924384
1.035266	0.946148
1.067911	0.953402
1.10781	0.964284
1.140455	0.964284
1.183982	0.967911
1.231136	0.971538
1.256526	0.971538
1.281917	0.971538
1.3	0.971538

Transformation Ratio $y = 18.686x^6 - 69.794x^5 + 93.888x^4 - 55.31x^3 + 14.903x^2 - 1.4744x + 0.0327$
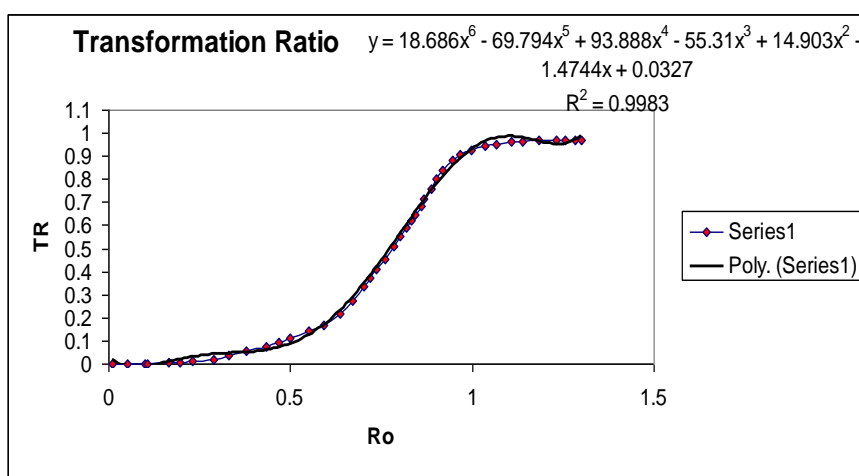
$R^2 = 0.9983$

FIG.2-Reconstructed Ro/TR diagram by Excel soft ware

Then these data were entered in Excel software and reconstructed TR/Ro diagram and the best curve fitted on them (FIG.2). The curve's equation is:

$$TR=18.686(Ro)^6-69.794(Ro)^5+93.888(Ro)^4-55.31(Ro)^3+14.903(Ro)^2-1.4744\ Ro+0.0327.. \ (1)$$

We calculated TR by Ro using equation (1) and could calculate initial TOC% by TR. sub consequently initial ISO TOC contour map for source rocks was prepared, for example initial ISO TOC map of Pabdeh formation is illustrated (FIG.3).

CONCLUSIONS:

1- Transformation ratio (TR) of the Pabdeh formation varies from 23% in Aghajari to 75% in Palangan oilfield, thus huge parts of the pabdeh formation in north part of northern Dezpul Embayment is transformed to hydrocarbon but in south part of northern Dezpul Embayment Pabdeh formation is either immature or early mature.

2-Average initial TOC % in Pabdeh formation is about 1.1-3% and in the Gurpi formation is 0.5-1.9%.

3-Estimating of TR is very important that is used by oil generation modeler soft wares.

4-By equation 1 and Easy Ro can add to oil generation modeler soft wares, TR vs. depth diagram.

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