Lithofacies and sedimentary environment of the Early Cenozoic conglomerate in the Zefreh area (northeast of Esfahan)

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Abstract

Two successions of the Early Cenozoic conglomerate, located in the west of the Central Iran zone (W of the Zefreh village, 45 km of NE of Esfahan) were examined. One of these successions (ca. 360 m thick) is conformably laid on the Eocene volcanoclastics, whereas the other (ca. 66 m thick) is unconformably laid on thick bedded limestones of the Eocene age. The distance between these two is approximately 4 km. Field evidences proposed that these rocks probably is time equivalent, and lateral extension of the shallow marine Qom Formation.

Seven following lithofacies were distinguished: 1) crudely graded bedded, massive, matrix to clast supported conglomerate (Gmm facies), 2) normal to inverse graded bedded, matrix to clast supported conglomerate (Gmg facies), 3) inverse graded bedded, clast supported conglomerate (Gci facies), 4) massive clast supported conglomerate (Gcm facies), 5) crudely to well bedded, clast supported conglomerate (Gh facies), 6) trough crass bedded, clast supported conglomerate (Gt facies), and 7) lenticular, massive sandstone (Sm facies).

Based on statistical data the Gmg, Gcm, and Gh facies are the main and the Gci, Gmm, and Sm are the minor facies in the first section. In the second section the Gmg, Gcm, Gci facies are the main and the Gh, Gmm, and Sm are the minor facies.

The main facies were originally deposited by debris flows, revealing that that these rocks were occurred in a dry alluvial fan. Palaeocurrent directions could show that the fan was extended to the northeast (from the first section to the second) in the study area.

Introduction

The study areas are located at 45 km of North East of Isfahan and near the west and east of Zefreh Village (Figure 1). These Areas are in central Iran near the Oroomieh-Dokhtar zone. The position of the base of the west section is 32°53´57” N, 52°15´39” E and the east section is 32°53´64” N, 52°43´76” E.

The west succession which conformably placed on the Eocene volcanoclastic rocks (Radfar 2002) is composed of the following lithostratigraphic subdivisions (figure 2):

Unit 1: It is composed of 33 m clastics and volcanoclastics including agglomerate and conglomerate rocks, formed by various pebbles. Several tuff levels were also recorded.

Unit 2: The unit consists of red, lens shaped peteromictic ortoconglomerates (ca. 209.6 m). The lenses are connected to each other without any lateral discontinuity. The contact with lower unit is sharpe.

Unit 3: The unit is discriminated by its specific grey coloration from the underlying red unit 2. The lithology is also characterized by peteromictic orthoconglomerats and is made up of welded lenses such as previous unit. Sand lenses rarely are seen in this unit. Recent alluvial sediments covered upper part of this unit. Thickness of this unit is 119 meters.

Conglomerate layers in the east succession conformably placed on the thick bedded limestones. A paleosoil layer exists between them. The limestone layers directly located on the volcanoclastic rocks. In this succession only unit 3 can be seen. Here, thickness of this unit is 57.77m. (figure 2). In general, conglomerate grain size is reduced in this unit against to West succession.

Methodology

The terriginous rocks were named based on Petty John's method (1975). Lithofacies were adopted to Mial (2006, 2005). The Fisher's method (1964) used in sequence stratigraphy and its terms were also adapted to Coe (2003) and Catunianu (2005).

Description

A) Petrofacies

The coarse grain terriginous rocks in these successions are composed of several different gravels. Most of these are basically unstable. These very thick to massive rocks relatively and significantly are expanses and their gravel grains are very large (pebble to cable) so according to Petijohn (1975) these rocks called extrabasinal conglomerates and based on their matrix frequency are orthoconglomerates. The limestone, dolomite and sandstone gravels are major components of these rocks, whereas volcanoclastic, volcanic, and the others gravels are less. However, gravel grains frequency is different from the base to tope of the sections. Volcanoclastic gravels are abundant in the base of the west section (in unit 1) but suddenly decreased upward the section (in units 2&3). Although In this profile, percentage of dolomite and limestone gravels increased in unit 3 but in unit 2 they are dominant. However, frequency of sandstone gravels has a increasing trend upward the section and are abundant in unit 3 but carbonate gravels (dolomite & limestone gravels) are much more (chart 1). Like west succession, unit 3 in East section has more carbonate gravels.

B) Lithofacies

In this study 7 lithofacies, including 6 conglomerate facies and 1 sandstone facies were determined based on Mial (2005). They are consisting of:

1- Gmm facies: matrix supported conglomerates with crudly normal grading belong to this lithofacies. According to Mial (1996), high viscosity debris flow occurred this lithofacies.

2- Gmg facies: the facies is formed of matrix supported conglomerats with inverse grading (figure 3e). This lithofacies can be made by Pseudoplastid debris flow (Mial 1996).

3- Gci facies: this facies consists of clast supported conglomerates with inverse grading. Mial (1996) believed that the facies is formed by the clast-rich cebris flow or pseudoplastic debris flow.

4- Gcm facies: clast supported conglomerates without any indicative structures (figure 3b) formed this facies. Pesudoplastic debris flow can make the facies (Mial 2006).

5- Gh facies: the facies like previous facies is formed from clast supported conglomerates but they have well bedding, imberication, and crudly gradding structures (figure 3d). Mial (1996) believed that longitudinal bedforms or lag deposits and or sieve despite can produces this facies.

6- Gt facies: clast supported conglomerates with trough crass bedding form the facies(figure 3d). The facies occurred in minor channels (Mial 1996).

7- Ss facies: this sandstone facies composed of fine to coarse sand grains (figure 3f). Scoure structures are the character of the facies. They can be made in result of sedimentation in the scours (Mial 1996).

Distributions of the lithofacies in these sections show that Gcm facies is the most frequent lithofacies in the study area. After that the Gmg facies is frequenc. Gh and Gmm facies also are abundant. Frequency charts (chart 2) reveals that the other conglomerate lithofacies and also sandstone lithofacies frequencies in the successions are rare. So the main lithofacies in these sections are: Gcm, Gmg, Gh, and Gmm; and the minor lithofacies are Gci, Gt, amd Ss. However, if the statistical study is based on the thicknesses of the lithofacies so it will be seen that the main lithofacies are Gh, Gmg, Gci, and Gcm and the minor lithofacies are Gmm, Gt, and Ss (chart 3).

Discussion and conculosion

The Fisher plots obtained (chart 4) could reveal sequence stratigraphy of the study area. In west succession two third order sequences can be recognized. The first sequence begins with an erosion surface so a type-1 sequence boundary (SB1) occurs. This sequence is covered by the second sequence and a type-2 sequence boundary (SB2) separates them from each other. Finally, recent alluvial deposits cover second sequence. The first sequence composes of HST and FSST. The second sequence begins with LST (figure 2). The abundant lithofacies in the HST are Gmg, Gmm, and Gmc. In the FSST Gmm disappears and instead Gmi adds. Gmm, Gmg, Gmc, and Gh are the most lithofacies in LST. In the East section also two third order sequences are revealed based on the Fisher plot. After an erosion surface on the volcanoclastic rocks, the HST of the first sequence begins. The paleosoil layer marks the end of the HST and the sequence. The upper and lower boundaries of the first sequence are confined by two SB1.

The main lithofacies could have been formed by debris flow, probably in an alluvial fan. Decreasing the sandstone lithofacies not only emphasized the reason but also showed that they were deposited in the mid upper part of the fan. Sequence stratigraphy data (following paragraph) showed, start up of the alluvial fan have been simultaneous with progress of adjacent sea water.

The sequence stratigraphy correlation reveals that after the Oligocene Sea transgression blanketed eastern part of the area (mfs), carbonates (HST) were deposited. On the western part of the area, the agglomerates and conglomerates (HST) were occurred. During the regressive cycle, sea water removed from the east and the paleosoil was developed. In the western part, sedimentation were continued and unit2 was formed (FSST). Finally in LST, sedimentation extended from the west to the east of the area.

Refrences

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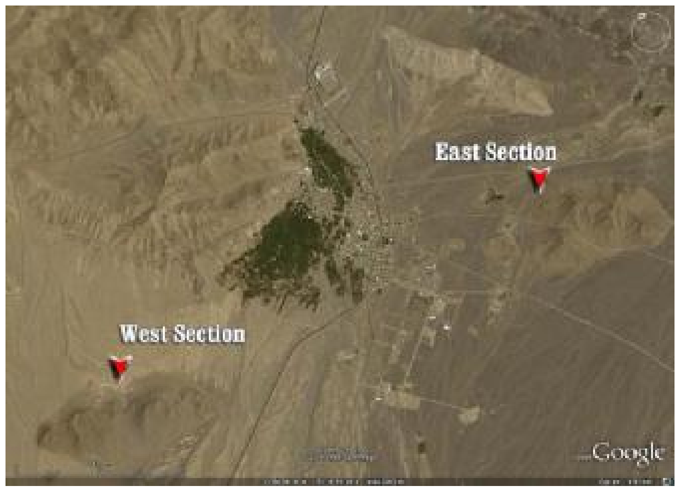

Figure 1) the location of the area study

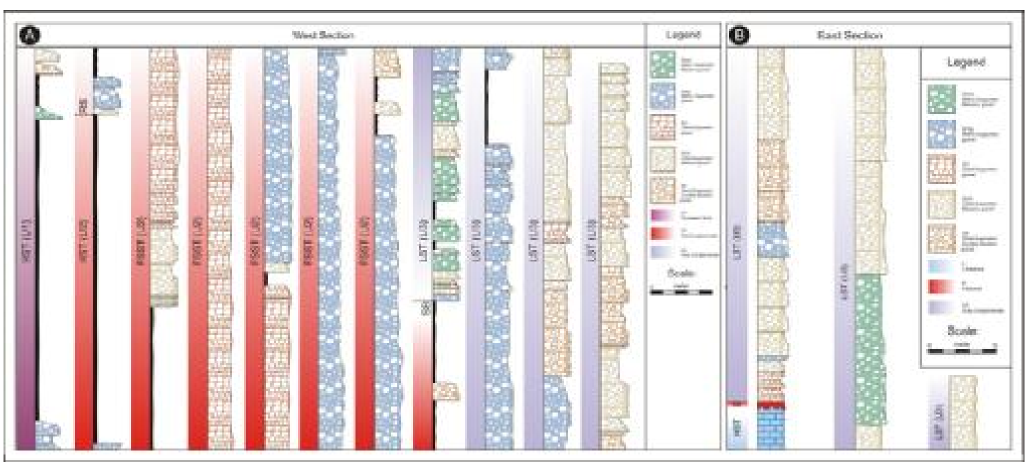

Figure 2) lithostratigraphy & sequence stratigraphy of the west (right, the thicknesses of the units mentioned in the text) and east (left) successions.

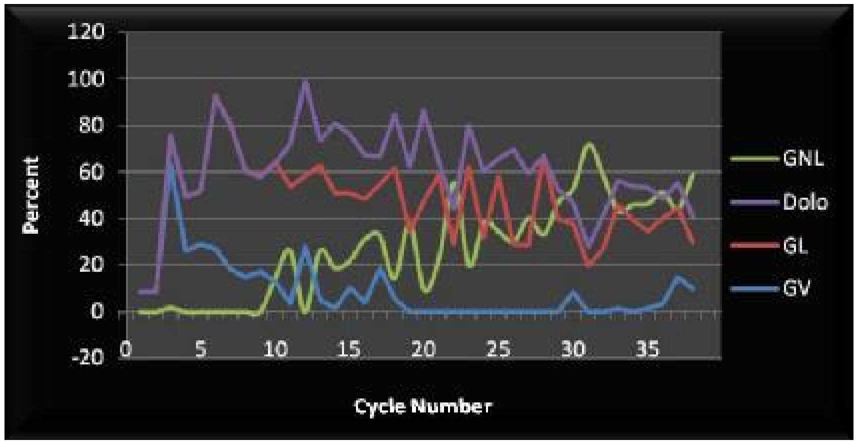

Chart1) distribution of the different gravels in the west section: GV=volcanic gravels, GNI= sandstone gravels, DOLO= dolomite gravels, GL= limestone gravels.

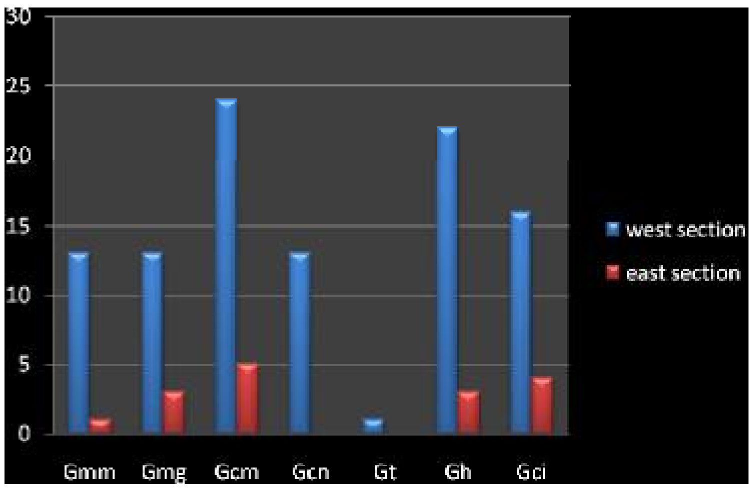

Chart 2) frequency chart in west profile based on repetition

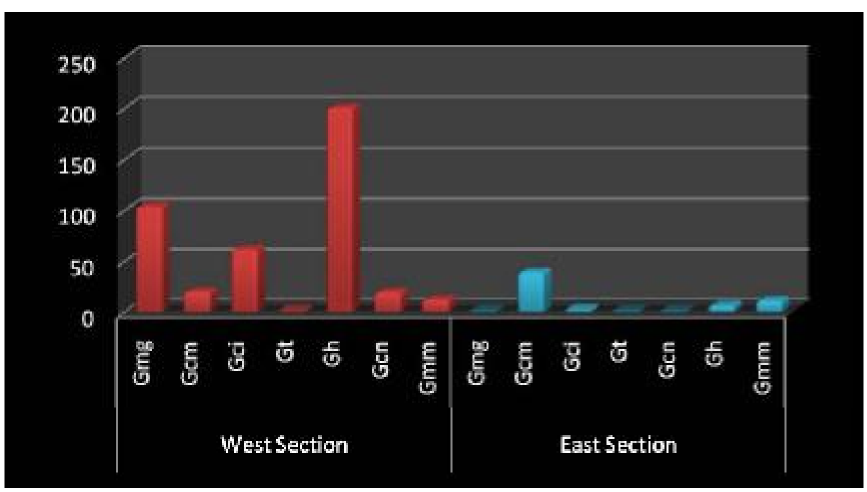

Chart 3) frequency chart in both of the sections based on thicknesses

Figure 3:

a) Gmg lithofacies b) Gcm lithofacies

c) Gh lithofacies d) Gt lithofacies

e) Gci lithofacies f) Ss lithofacies