Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/01/jls.htm
2015 Vol.5 (S1), pp. 4615-4620/Oskuei et al.
Research Article

STRATIGRAPHY AND SEDIMENTARY FACIESES OF PLEISTOCENE AGGLOMERATES IN NORTH WEST OF TABRIZ, NW IRAN

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ABSTRACT
In North West of Iran, north of Tabriz and Espiran region, around Bohlul Daghi mount, significant expansion of agglomerate sediments and muddy sandstones with conglomerate interbeds, andesite and sometimes pebbly mudstone can be seen. This pyroclastic unit with Pleistoceneage and 322 m thickness is deposited unconformably on Upper Red formation. In these deposits, sedimentary structures are made, for example: greaded beding, scoured or channel, coarse-grained and fine-grained lenticular structure, cross bedding, flat laminations and massive beds. Gh, Gmm, Gms, Gm coarse-grainedclastic sedimentary facieses, Se, St, Shmedium-grained, and also Fl, Fm, Fcs fine-grained facieses were differentiated. Based on the microscopic properties of pyroclastic rocks can be the presence of Quartz, Biotite, Amphibole, Plagioclase, Chlorite and glass texture minerals. Regarding the texture properties and structures and lateral and vertical expansion of facieses, we can consider the lacustrine sedimentary condition for lower part of stratigraphic column and braide driver condition of Trellheim type for upper part of stratigraphic column that gradually lacustrine condition has turned to riverine condition because of its regression.
Keywords: *Stratigraphy, Agglomerate, Sedimentary Facies, Sedimentary Structure, Lakes, Braided River, Tabriz, Iran*

INTRODUCTION
From geographic segmentation point of view, the study section is located in East Azerbaijan province, in 15 km distance of northwest of Tabriz city. It is located between ◦46′18◦ 27′to46′19◦ 69′longitudes and 38′14◦60′to 38′ 14◦77′latitudes.Access to this area is possible from Tabriz road towards Anakhatun and Espiran villages (Figure 1).
Most outcrops of Espiran region belong to Cenozoic stratigraphic units and rocks which mostly are constructed from Mioceneclastic sediments and Pliocene – Quaternary deposits.

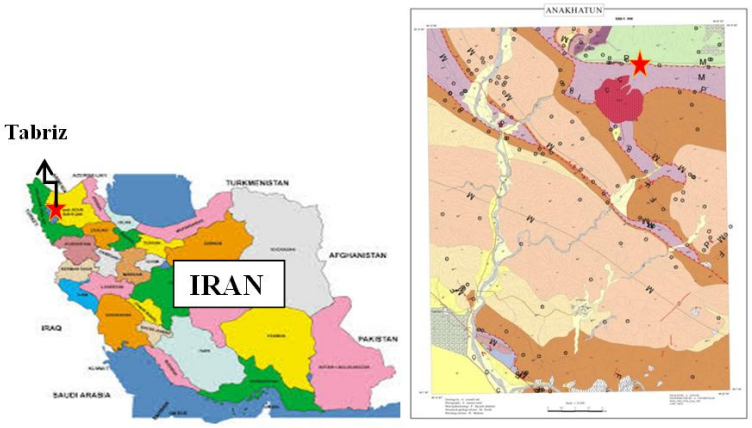

Figure 1: Geological location of study area

Stratigraphy
The study section in this area includes agglomerate strata and muddy sandstone with conglomerate interbeds, andesite and sometimes pebbly sandstone. The attributed age to this sequence is Pleistocene. This stratigraphic unit is deposited with angular unconformity on Upper Red formation of Miocene age with 322 m thickness which includes thick, red, gypseous and saline clasticbeds (Figure 2).

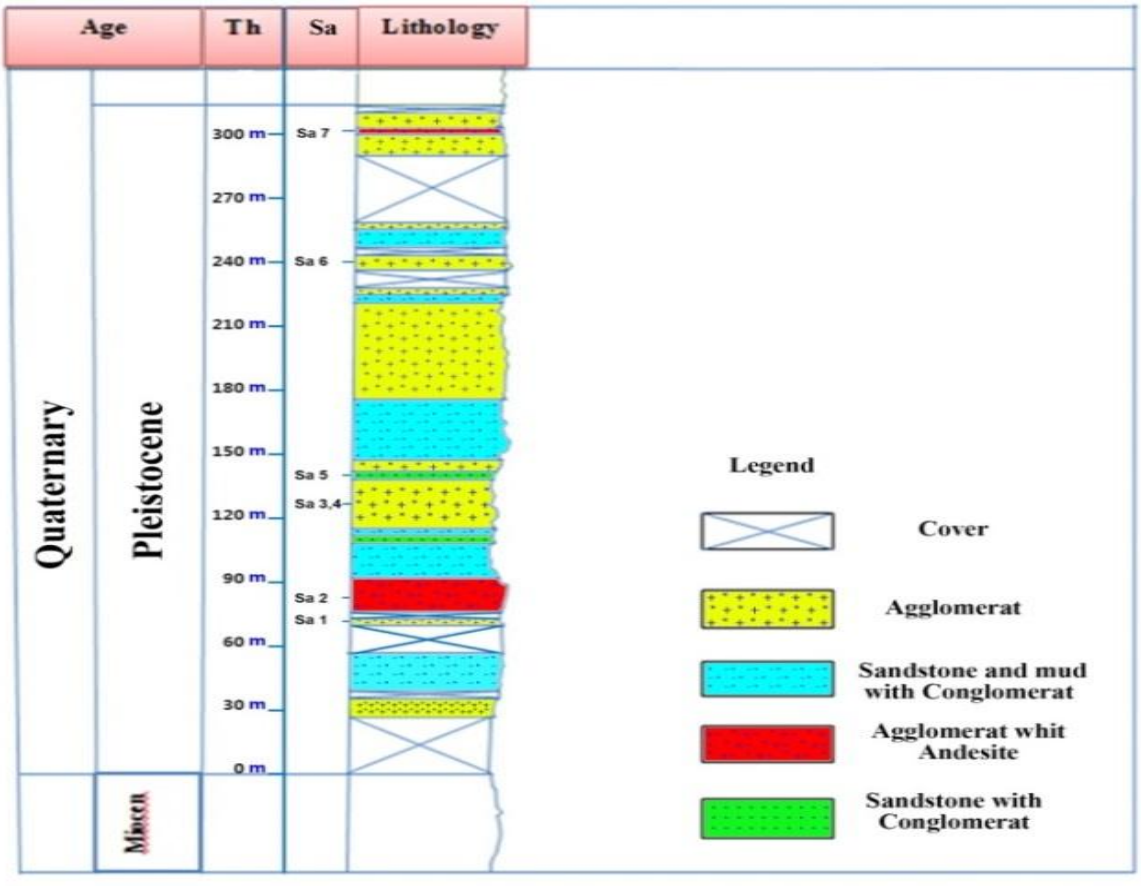

Figure 2: Stratigraphy column of Pleistocene agglomerates in NW Tabriz

Sedimentary Structures Identified in the Study Section

Greaded Bedding: In this type of bedding the size of sedimentary particles becomes gradual small or large in the thickness of a sedimentary bed in a way that matrix fine – grained particles can be seen between coarse – grained particles in lower or upper parts of these strata. This confirms the sedimentation of inspissated flows like muddy flows (Mahari, 2009) and the effect of sudden speed decrease at the time of sedimentation (Figure 3).

Scoure / Channel Structure: Shapes resulting from stream erosion on the surface of lower bed which are filled by upper sediments and them form cuts or scours in small scale (cm) and channels in larger size (m) (Figure 3).This sedimentary structure shown sedimentation in continental conditions.

Lenticular Strata: In the study rock units based on the sedimentary circumstances, sometimes lenticular strata are formed which are representative of fine – grained lenticulars between coarse – grained deposits that often have limited lateral and vertical expansion and are made on the border of the high – energy main environment and in floodplain dents because of compulsive sedimentations. Also if the energy of the environment increases for a short time, it causes the movement of the coarse particles (Figure 3). Lenticular strata are often the representative of sedimentation in limited environments like river channel.

Cross Bedding Structure: In this kind of structure a series of diagonal flat beds are made that on its upper and lower horizontal beds (Figure 3).

Flat Laminations: These rock units sometimes include very thin and regularstrataand laminations that can be representative of lacustrine environments. According to few energy changes in lakes and environmental calmness, very thin beds and regular laminations are of lacustrine deposits' characteristics (Figure 3).

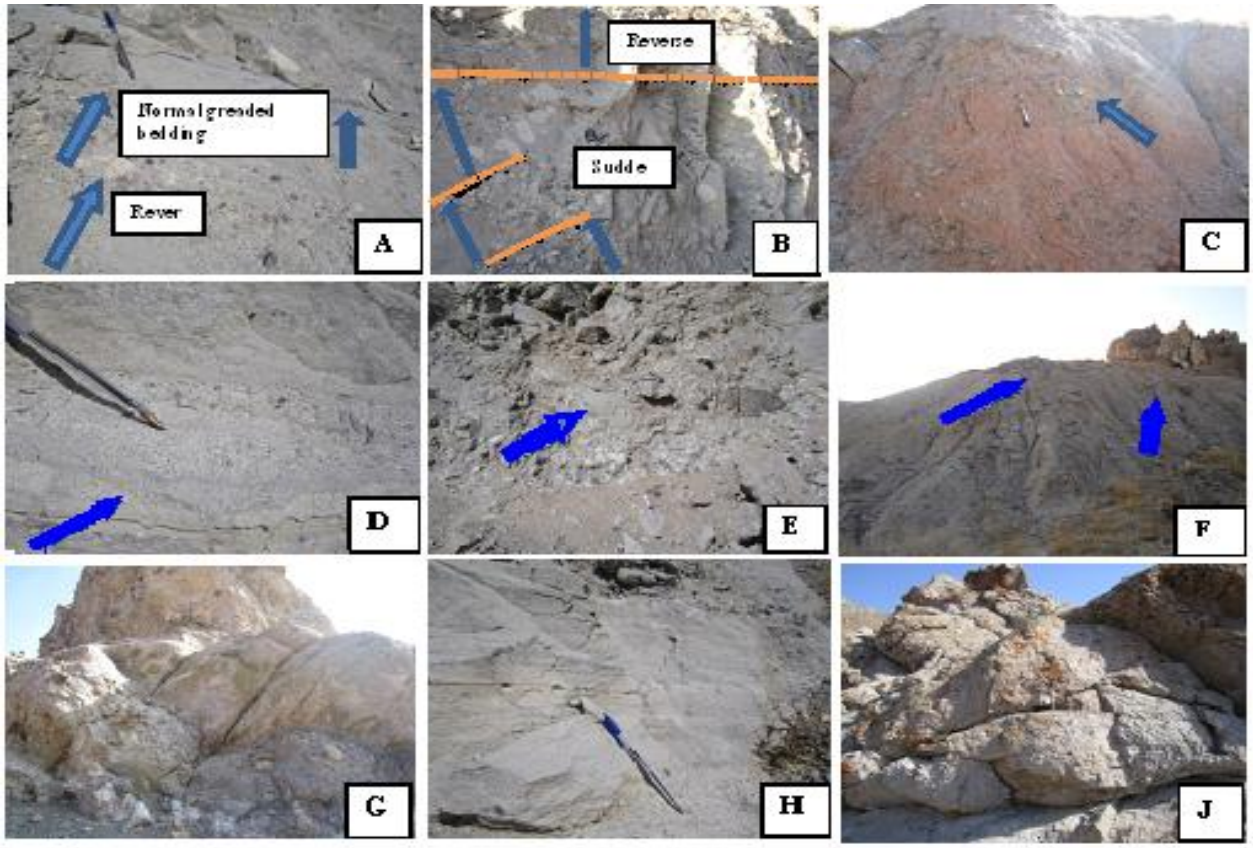

Figure 3: Identified sedimentary structures; A: normal and reverse sedimentary cycles, B: suddenly cycles boundary, C: channel structure, D: scoured structure, E: fine – grained lenticular strata in coarse – grain deposits, F: coarse – grained lenticular strata in fine – grain deposits, G: cross bedding structure, H: flat laminations, J: masive strata structures

Massive Strata: The formation of very thick and massive strata can be the representative of very fast sedimentation or unchangeable environmental condition for a long time (Figure 3). Muddy flows with low expansion and excessive sediment volume on border of mountainous areas and also lahar flaws on the border of volcanoes have made these facieses (Mahari, 2009). The sediments which have formed these facieses are consisting of poorly sorted clastic grains and show the inverse greaded bedding structure with mud texture.

Sedimentary Facieses Differentiation

The rock units of the study section are generally categorized in three groups: Gravelly coarse– grain, sandy average – grain and muddy fine – grain which are named based on facies's codes of Miall (1996), and are in three facieses sets of riverine, lacustrine and debris flows. The identified rock facieses in the area are: Gm, Gms, Gh, Gmm, Sh, St, Se, Fm, Fsc, Fl.

Gms Facies (Massive Gravel with Clay – Sandy Matrix)

The presence of excessive matrix of clay and sand between the coarse particles of gravel is the characteristic of this facies that does not have sedimentary structure. Lake of imbrication, absence of greading and presence of reverse greading are representatives of sedimentation caused by debris flows (Blair and Mcpherson, 1999) (Figure 4).

Gmm Facies (Gravel with Massive Bedding and Matrix)

In this facies, gravel grains can be seen sporadically in a context of clay matrix which is poorly sorted. The grains are often subangular to subrounded with no layering (Figure 4). These characteristics show

short time movements near the origin. This facies is formed by debris flaws with high viscosity and energy which have high plasticity (Miall, 2006). The formation of this facies can be related to fluid phases with high density, high energy and also debris flows (Houben, 2007).

Gm Facies (Gravel with Massive or Incomplete Horizontal Layering)

This facies is mainly composed of pebble – sized particles. Its geometric shape is mainly like large area lenticular, wedge – shaped and channel – shaped. Its lower border is erosional and mainly wave – shaped. Its grains are good sorted and are often semi – rounded (Figure 4).

Gh Facies (Gravel Grain Supportive with Horizontal Layering)

The grains of these sediments are fine – grained to coarse – grained which have angled to semi – angled roundness and are poorly sorted (Figure 4). The gravel and sand particles have been moved and then deposited by tensional flow (bed load) and sometimes sand particles have been moved and deposited by hovering flow (hovering load) and under a high energy river in flow.

Sh Facies (Fine – Grained to Coarse – Grained Sand, with Horizontal Layering)

This facies is formed of fine – grained to medium – grained sandstone with horizontal lamination (Figure 4). This facies is the result of low and high speed water flow (Lee and Chough, 2006). Generally, coarse – grained sandstones are formed in low speed water flows and fine – grained sandstones are formed in high speed water flows (Miall, 2000). This facies can be made in upper parts of point bar or inside the channel (Miall, 1996, 2000; Khalifa and Catuneanu, 2008).

Se Facies (Sand with Erosional Surface and Some Coarse Horizons)

This facies is characterized by the presence of destruction surface with coarse horizons on top of it which shows the erosion and lack of sedimentation (discontinuities) in the base (Figure 4).

St Facies (Grained to Very Large–grained Sand, Probably Pebbled with Cross Bedding)

This facies is identified by course to fine – grained sand deposits and also with diagonal lenticular classification (Figure 4). The inferior part of this facies is erosional which it's geometric and channel shape and lenticular shape shows that the sedimentation has taken place in a channel or in an underwater hills under the effect of low flow in temporary rivers (Miall, 1992).

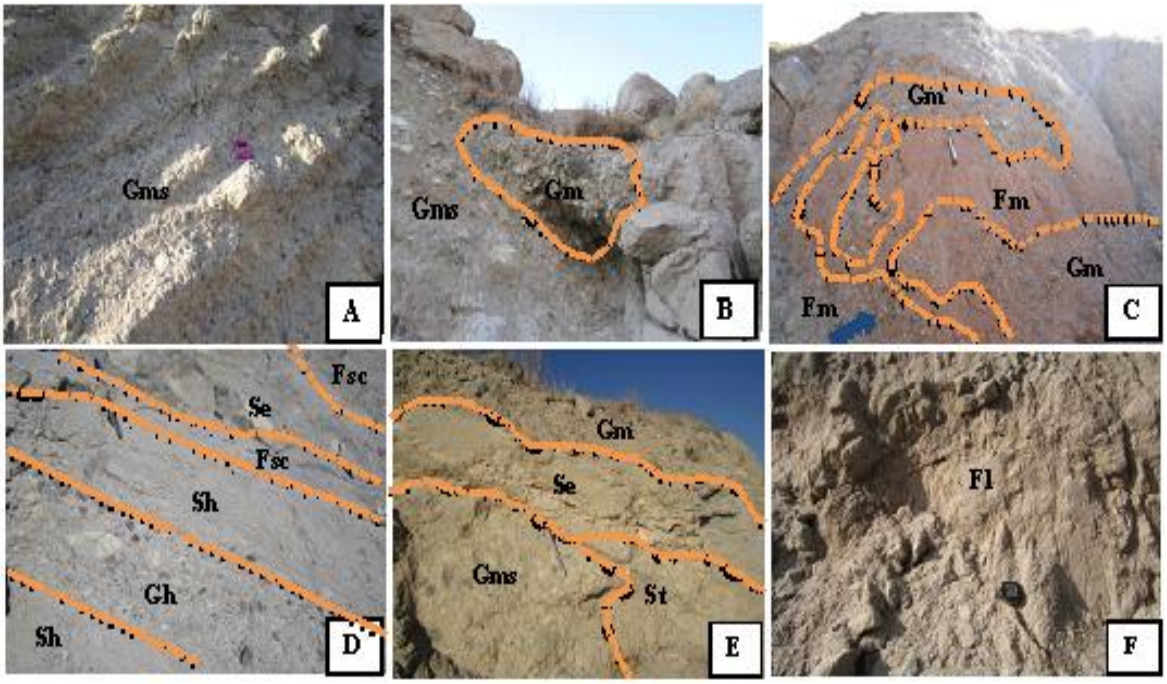

Figure 4: A: Gmsfacies, B: Gms, Gm facieses, C: Gm, Fm facieses, D: Gh, Sh, Se and Fsc facieses, E: Gm, Gms, St and Se facieses, F: Fl facies

Fsc Facies (Clay and Silt, Massive or Laminated)

This facies is identified by clay and silt deposits with massive or laminated sedimentation which is the representative of decrease of river flow and therefore small particles of clay and silt are deposited (Figure 4).

Fm Facies (Massive Clay and Silt with Mud Crack)

This facies is formed of small particles of clay and silt which has no layering (Figure 4).Therefore, it can be formed as the result of periodic flooding in the environment outside of riverine channel, as a coating on the dams, inside the rivers or as the channel filler (Ito *et al*., 2006).

Fl Facies (Sand, Silt, Clay with Thin Lamination, Very Tiny Ripple Marks)

The property of this facies is the presence of sand, silt and clay particles with thin laminations (Figure 4). The general characteristics of this facies show that these sediments are deposited in low energy conditions and in riverine border environments or in floodplain with low slope on the flood stages with changeable energy (Hjellbakk, 1977; Miall, 1997).

The Textural Features

The roundness of the grains: According to the survey done on the sections, it can be deduced that most of the grains are angular to subangular (Figure 5). It represents that grains and their components are of falling type and indicates the lake of movement or minimal movement prior to sedimentation.

The sorting of the grains: In the study sections, mostly the grains are poorly sorted. Poorly sorting is because the energy of the environment caused by flows did not have effect. The falling grains and components which have no transmission or little transmission, did not have enough time for sediment differentiation or size separation of components so they often show poor sorting (Figure 4).

The arrangement or relation between grains: The placement and the space between the rock's grains are called arrangement of the grains. The collateral survey of grains in microscopic sections revealed that the grains are in form of point contact; tangential, concave and convex (Figure 5).

Debris Flow Sediments, Lahar

These sediments have higher viscosity than riverine sediments because they contain excessive clay. Reverse grading structure are formed of clay texture which are poorly sorted (Figure 5).

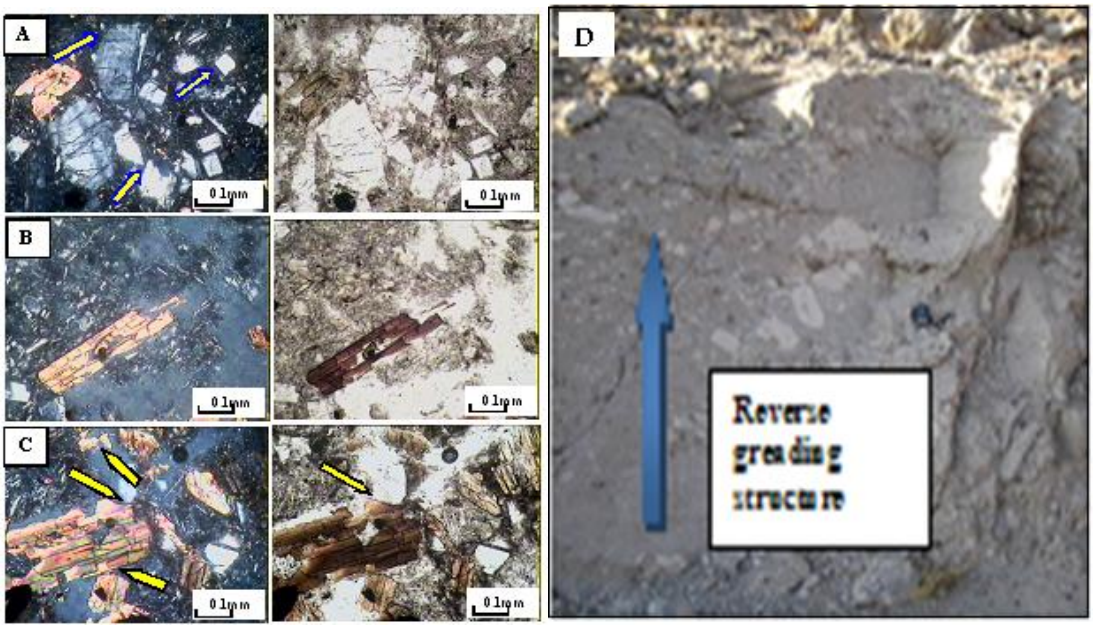

Figure 5: A: angular and subangular grains, B: poorly sorted grains, C: grain arrangement in form of point, tangential, concave and convex contact, D: reverse greading structure indebris flow deposits

CONCLUSION

According to field and laboratory studies and based on the findings and the results of this research, the bellow points can be concluded:

1. In north part of Tabriz in Espiran region, a significant expansion of agglomerate deposits and mudy sandstone with conglomerate interbeddeds, andesite and sometimes pebbled sandstone on the border of mount BohlulDaghi can be seen.
2. Agglomerate deposits of Espiran are placed unconformably on clastic facieses of upper red formation.
3. These deposits are the result of active volcano of Bohlul-Daghi in Espiran region, north west of Tabriz, at the time of Pleistocene.
4. The measured thickness of agglomerate unit is 322 m.
5. These deposits are generally composed of agglomerate, andesite and mudy sandstone with the conglomeratic inter beddeds.
6. The sedimentary structures that are formed in different levels of these deposits are: greaded bedding, scoured or channel, coarse – grained and fine – grained lenticular, cross bedding, flat laminations and massive structure.
7. The identified clastic sedimentary facieses in these series of deposits are: coarse – grained: Gm, Gms, Gh, Gmm, medium grained: Sh, St, Se and fine – grained: Fm, Fl, Fsc.
8. According to lateral and vertical expansion of facieses and the structure kind and its texture, lacustrine sedimentary condition and also slash riverine condition of Trellheim type are identified.
9. According to formed sequences, it is considered that lacustrine sediments are filled and riverine facieses are deposited on lacustrine sediments under the effect of nearby volcanos.

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