Sedimentology, lithofacies analysis and depositional model of Baz-e-Hour river, SW Mashhad

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Abstract

The Baz-e-Hour watershed is located in the center of Khorasan –e- Razavi province. This area has been located between Binaloud geological zone in the north, and Central Iran zone in the south, which influenced by tectonical and erosional causes and composed of Marl, Sandstone and green Tuffa (Eocene) but main part of this region especially in south are formed by Ophiolite. This watershed has an elongate form and its surface area is more than 129.22 square kilometer. Based on this study, the Baz-e-Hour River has a braided pattern with gravely bed. Sedimentological studies along rivers in Baz-e-Hour basin show that three basic factor (sudden changes in slope gradient, floods events and distributaries) are the main reasons for changes in texture of bed load sediment within the channel as well as the break in sedimentary links. Mafic and ultramafic rocks are the main source of this sediment. Lithofacies which identified in this watershed include gravelly (Gmm, Gmg, Gcm), sandy (Ss, Sh, Sm) and muddy (Fm, Fl, Fr, Fsm). Based on lithofacies, boundary surface and current direction architecture elements identified in main river of Baz-e-Hour basins include: 1) sediment gravity flow deposits, (Element SG) 2 - lateral accretion deposits , (Element LA) ، 3- sandy bed form deposits (Element SB) 4- overbank fines (Element FF). Also, based on litofacies and architectural elements, Facies models have been purposed for the Baz-e-Hour river from upstream toward downstream as follows: 1) gravel braided river with sediment gravity flows, 2 - gravel bed meandering river, 3- sandy meandering river and finally, 4- fining grain meandering river. This information can be applied in sedimentary studies and watershed management in khorasan -e- Razavi and Iran.

Keywords: *Baz-e-Hour River, Sedimentology, Lithofacies, Architectural elements, Depositional Model*

1- Introduction

The important roles of rivers are erosion, produce, transport and deposition of the sediment and change the earth's morphology, which are favored by scientists. This issue is lead to broad studies by different researchers about rivers and the effective processes in this environment as suggested by Mclaren, (1981); Sun et al., (1996) Rice, (1999); Hoey and Bluck, (1999) Asselman and Middlekoop, (1998); Gomez et al., (2001); Paphitis et al., (2001); Kleinhans, (2001); Surian, (2002) and Moussavi – Harami et al., (2004). Wherever Baz-e-Hour River are not study in sedimentology and sedimentary model's sight yet, so the purposes of this research are mainly identification and separation lithofacieses based on the

analysis of architectural elements, sedimentary texture, explanation of sedimentary condition and propose the sedimentary model.

2- The location of the study area

 The study area is one of the subbasins in central plain watershed which located between 58°, 12' to 59°, 30' longitude and 36°, 4' to 35°, 41' latitude with 129.22 kilometer squares in Khorasan-e-Razavi province. This area is also located nearby 60 km of Mashhad – Torbat-e-Heidarieh road.

3- Geology Setting

The studied area is located between Binalood geological zone in north and central Iran in south (Darvishzadeh, 1380). The majority parts of Baz-e-Hour watershed are dominated with ophiolites mélange of Torbat-e-Heidarieh. In order to tecctonical position of this area, it is considered that ophiolites mélange complex is formed in rift area which originated from extension of ocean crust (Razmarar, 1369). In the north of this watershed the main geological members are marl, sandstone and green tuff with Eocene age, which not resistance in front of erosion. Also in the central part of this watershed gypsum layer with strike of NW-SE are deposited (Fig. 1).

4- Sedimentology

Baz-e-Hour River is originated from Ghar Mountain which first of all flows east to west and then north to south with the direct of Baz-e-Hour Dam. The Baz-e-Hour River has a braided pattern with gravely bed. Sedimentological studies along rivers in Baz-e-Hour Basin show that three basic factors (sudden changes in slope gradient, floods events and distributaries) are the main reasons for changing in texture of bed load sediment within the channel as well as the break in sedimentary links. Mafic and ultramafic rocks are the main sources of sediments. The textural parameters show that the sediments are mainly poorly sorted, positively skewed and plathykurtic Lewis and McConchie (1994) (Figures 2, 3a, b and c).

5- Lithofacies

Based on Miall's classification (1996 and 2000) identified lithofacies are as follows:
Gravelly (Gmm, Gmg, Gcm), sandy (Ss, Sh, Sm) and muddy (Fm, Fl, Fr, Fsm) (Table 1).

6- Architectural elements and sedimentary models

Based on identified lithofacies, boundary surfaces and current direction architecture elements in main river of Baz-e-Hour basin include: 1- sediment gravity flow deposits, (Element SG) 2 - lateral accretion deposits, (Element LA)، 3- sandy bed form deposits (Element SB), 4- overbank fines deposits (Element FF). Also, based on lithofacies and architectural elements, facies models have been purposed for the Baz-e-Hour river from upstream toward downstream as follows: 1) gravel braided river with sediment gravity flows, 2- gravel bed meandering river, 3- sandy meandering river and finally, 4- fining grain meandering river (Table, 2).

7- Conclusion

Sedimentological studies in Baz-e-Hour basin show that three basic factors (sudden changes in slope gradient, floods events and distributaries) are the main reasons for changes in texture of bed load sediment within the channel as well as the break in sedimentary links.

Lithofacies which identified in this watershed include gravelly (Gmm, Gmg, Gcm), sandy (Ss, Sh, Sm) and muddy (Fm, Fl, Fr, Fsm). Based on lithofacies, boundary surface and current direction architecture elements identified in main river of Baz-e-Hour Basins include: 1) sediment gravity flow deposits, (Element SG) 2 - lateral accretion deposits , (Element LA)‹ 3- sandy bed form (Element SB) 4- cverbank fines (Element FF). Also, based on lithofacies and architectural elements, facies models have been purposed for the Baz-e-Hour River from upstream toward downstream as follows: 1) gravel braided river with sediment gravity flows, 2 - gravel bed meandering river, 3- sandy meandering river and, 4- fining grain meandering river.

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Table1. Facies classification in Baz-e-Hour Basin (Modified from Miall 1996, 2000)

Interoperation	Sedimentary Structure	Facies	Facies code
Plastic debris flow (high-strength, viscous)	Weak Grading	Matrix-Supported, Massive Gravel	Gmm
Pseudo plastic debris flow (low-strength, viscous)	Inverse to normal grading	Matrix-supported, Gravel	Gmg
Pseudo plastic debris flow (inertial bedload, turbulent flow)	----------------	Clast -Supported, Massive Gravel	Gcm
Plane – bed flow (critical flow)	Horizontal lamination parting or streaming lineation	Sand, very fine to coarse, may be pebbly	Sh
Sediment-gravity flow deposits	Massive, or faint lamination	Sand, fine to coarse	Sm
Scour fill	Broad, shallow scours	Sand, fine to very coarse, may be pebbly	Ss
Overbank, abandoned channel, or waning flood deposits	Fine lamination, very small ripples	Sand, silt, mud	Fl
Root bed, incipient soil	Massive, roots, bioturbation	Mud, silt	Fr
Overbank, abandoned channel, or drape deposits	Massive, desiccation cracks	Mud, silt	Fm

**Table2. Architectural Elements and Sedimentary Models in Baz-e-Hour basin
(Modified from Miall 1996, 2000)**

| Characteristic elements	Principle parameter	Sediment type	Braiding parameter	Sinuosity	Style name
SG	Gmm ,Gmg ,Gcm	Gravel, minor sand	High	Low	Gravel Braided with Sediment Gravity Flows
LA	Sh ,Sp ,St ,Se ,Sl ,Gm	Gravel, minor sand and fines	Intermediate	Int. to high	Gravel Bed Meandering River
SB	Sh, Ss, Sm	sand and minor fines	Low	High	Sandy Meandering River
FF	Fsm ,Fl ,Fr	Fine sand, silt, mud	Low	High	Fining Grain Meandering River
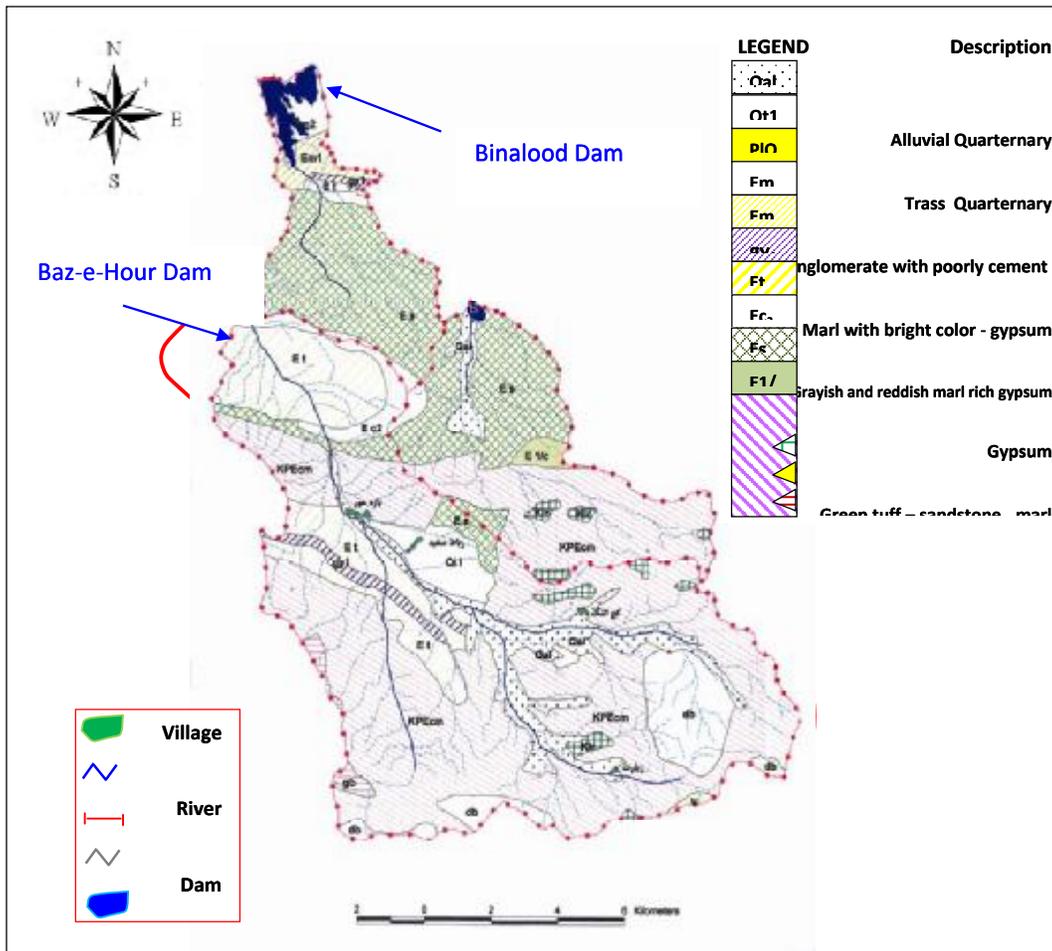
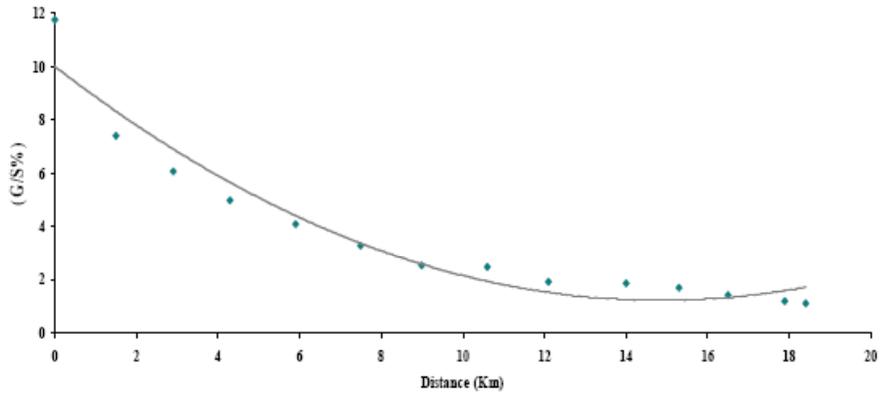**Fig. 1: Geological map of the study area**

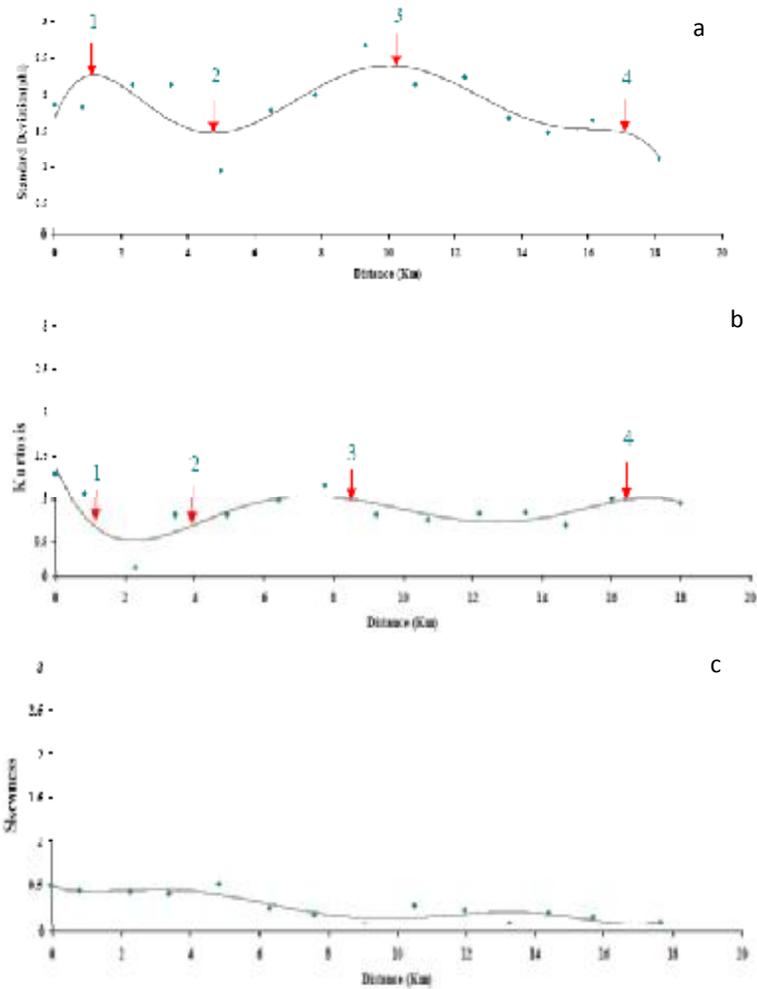**Fig. 2: Gravel/sand ratios of Baz-e-Hour River**

Fig. 3: the variations diagrams of textural parameters a) Standard deviation, b) kurtosis and d) skewness. The arrows show the relation between Standard deviation and kurtosis whenever Standard deviation changed the kurtosis has been changed similarly.