Lithofacies and Architectural-Elements Analysis of Fluvial Deposits in the Shahrud Drainage Basin, Qazvin Province, Iran

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Abstract

A part of the Shahroud drainage basin located northeast of Qazvin province, consists of two sub-basins (Alamoutrud and Taleghanrud). Structurally, the study area is part of southern-central Alborz zone and geologically is composed of very thickly Eocene volcanic units and Miocene terrigenous sediments. Lithofacies identified in this drainage basin include gravelly (Gmm, Gmg, Gcm, Gh), sandy (Sp, Sh, Sm) and muddy (Fl, Fm). Architectural elements identified include CH, GB, SB, LA and FF. Base on architectural elements and lithofacies sedimentary models for Shahrud river from upstream toward downstream respectively are as follows: 1: shallow gravel braided river, 2: gravel wandering river, 3: gravel meandering river, 4: sandy meandering river and 5: fine grain meandering river.

Keywords: *Lithofacies; Architectural elements; Depositional model; Shahroud Drainage Basin.*

Introduction

The Shahroud drainage basin is a part of Caspian Sea great drainage basin and a part of this drainage located northeast of Qazvin province, consists of two sub-basins (Alamoutrud and Taleghanrud). Structurally, the study area is part of southern-central Alborz zone and geologically is composed of very thickly Eocene volcanic units and Miocene terrigenous sediments. This watershed has an elongate form and its surface area is more than 5070 square kilometer. More than 70 percentages of sediments in studied samples from upstream is gravel, while in the samples from downstream, more 70 percentage is dedicated to the sand and mud size. Studies indicate that, two factors, Hydraulic sorting or selective transport and abrasion, have important role in fining trend in this watershed basin.

Fluvial deposits are dominated by clastic material. The simplest classification is a three component one using gravel, sand, and fine-grained materials. Fine-grained components can include mud, silt, and very fine-grained sand. Some lithofacies also contain organic matter that is an undesirable contaminant for aggregate applications. Table 1 presents a list of 9 lithofacies classes with associated names, descriptions, structures, and genesis.

Gravelly facies: Individual clasts may reach more than 20 cm in diameter but the mean size generally is within the pebble range (2-64 mm). Sorting is variable.

Sandy facies: Included in the sandy facies are deposits ranging from very fine to very coarse sand; the coarser beds commonly are pebbly. Sorting is extremely variable, and may be in part a reflection of the sorting in the source beds.

Fine-grained facies: Silt and clay may comprise a very small percentage of a braided-stream deposit, but their presence is of importance because of the genetic implications that can be deduced from their position in the bed sequence.

Architectural elements

Architectural elements can be found in various combinations in fluvial system channels. One additional element, floodplain fines (FF), is also considered here as it one of the elements of overbank environment that may be found in abandoned channels. The elements are the channel, gravel bars and bedforms, hollow deposits, sediment gravity-flow deposits, sandy bedforms, downstream-accretion macroforms, lateral accretion deposits, and laminated sand sheets. Each architectural element will be discussed in turn. Each element can consist of one or more lithofacies as given in Table 2. If these elements are sufficiently large they can be readily identified on low-level aerial photographs of modern rivers. One or more of these elements may be encountered in sand and gravel deposits suitable for aggregate. Relationships between elements can be complex, reflecting multiple truncations of one or more previous deposits and the overprinting of one or more new ones. The discussion that follows is more extensive for those architectural elements that are more likely to be likely sources of suitable sand and gravel.

Table 1: Lithofacies and sedimentary structures in fluvial deposits in the Shahrud Drainage Basin (modified after Miall, 1996)

Facies	Facies code	Description	Structure	Genetics
Gravely	Gmm	matrix-supported, mass	Weak grading	Plastic debris flow, high strength & viscous
	Gmg	matrix-supported	Inverse to normal Grading	Pseudoplastic debris flow, low strength, viscous
	Gcm	clast-supported, mass	None commonly seen	Pseudoplastic debris flow (inertial bedload, turbulent flow)
	Gh	clast-supported, crudely bedded	Horizontal bedding, Imbricated	Longitudinal bedforms, lag deposits, sieve deposits
Sandy	Sp	fine to very coarse, may be pebbly	Solitary or grouped planar cross-beds	Transverse and linguoid (2-D) dunes
	Sh	Very fine to coarse, may be pebbly	Horizontal lamination	Plane-bed flow (critical flow)
	Sm	fine to coarse	Massive, or faint lamination	Sediment-gravity flow deposits
Muddy	Fl	Sand, Silt, mud	Fine lamination, very small ripples	Overbank, abandoned channel, or waning flood deposits
	Fm	Mud, Silt	Massive, desiccation cracks	Overbank, abandoned channel, or drape deposits

Table 2: Architectural elements in fluvial deposits in the Shahrud Drainage Basin

Element	Symbol	Principal lithofacies assemblage	Geometry and relationships
Stream channels	CH	any combination	Finger, lens or sheet; concaveup erosional base; scale and shape highly variable; internal concave-up secondary erosion surfaces common
Gravel bars and bedforms	GB	Gh	Lens, blanket; usually tabular bodies; commonly interbedded with SB
Sandy bedforms	SB	Sp, Sh	Lens, sheet, blanket, wedge; occurs as channel fills, crevasses splays, minor bars
Lateral accretion deposits	LA	Sp, Sh, less commonly Gmm, Gmg	Thin to thick blankets; commonly interbedded with SB; may fill abandoned channels
Overbank fines	FF	Fl, Fm	Wedge, sheet, lobe; characterized by internal lateral accretion surfaces

Sedimentary models:

Shallow gravel braided river: This model occurs in larger gravel-bed streams, such as Trunk Rivers, and in some large alluvial fans. The valley contains three or four distinct topographic levels, with the higher levels covered by sparse to dense vegetation. The lowest level is that of the active channel and is similar in all respects to that of proximal alluvial fan or outwash braidplain river . Higher levels are active only during high stage and characteristically accumulate deposits of SB. A floodplain may or may not form a significant part of the system, depending on valley width and channel stability. Lateral migration of channels, as for example by distributary shifting on alluvial fans, causes superimposition of successively higher terrace levels, and the generation of upward-fining sequences. These may be thicker than the depth of the channel if they are developed by distributary migration on a rapidly subsiding fan (Fig. 10.

Gravel wandering river: This model typifies gravelly rivers of high sinuosity. Typically there is one main, active channel with bars and islands and occasional subsidiary channels. The latter commonly are initiated as chute channels. Sedimentation occurs on large, flat-topped point bar and side bar complexes. These commonly show a downstream decrease in grain size, with gravel sheets, lobes or foreset bars at the head, and sand dunes or sand waves at the tail. Lateral accretion of these bar complexes is common, and the LA element should be recognizable in large outcrops. Information about the floodplain of this class of river is sparse, and it is not known whether crevassing and crevasse splay deposits are common (Fig. 2).

Gravel meandering river: This model represents the typical "coarse-grained meandering stream", with distinctive, gravel-sand or pebbly-sand point bar complexes. The accretionary face of the bar is crossed by numerous sandy bedforms, including dunes and sand waves. Meander scars and abandoned channels are common in the floodplain. Fining-upward cycles may or may not be developed, depending on meander sinuosity and flow patterns around the bend. The upper South Platte River and the Amite River are typical modern examples (Fig. 3).

Sandy meandering river: This model illustrates the classic sandy meandering stream. The point bar accretionary face usually is of simpler geometry, with fewer, smaller scale bedforms than in previous model. Accordingly, well-developed epsilon cross-bedding is to be expected in cross section. Meander scars, abandoned channels and crevasse splays are common (Fig. 4).

Fine grain meandering river: This model illustrates a highly sinuous, suspended load stream. The overall geometry is similar to that of model 6, but differs in detail because of the finer grained sediment load (fine sand, silt, mud). Point bar accretion surfaces dip steeply (up to 25°), and have a simple geometry, typically planar or with banks or benches indicating downstream flow separation and the development of incipient scroll bars. Ripple marks are typically the most abundant flow regime bedform present. Gravel lags and cross-bedded medium to coarse sands may occur at the base of the point bar. E.H. Koster reports that many examples of this model may be estuarine in origin (Fig. 5).

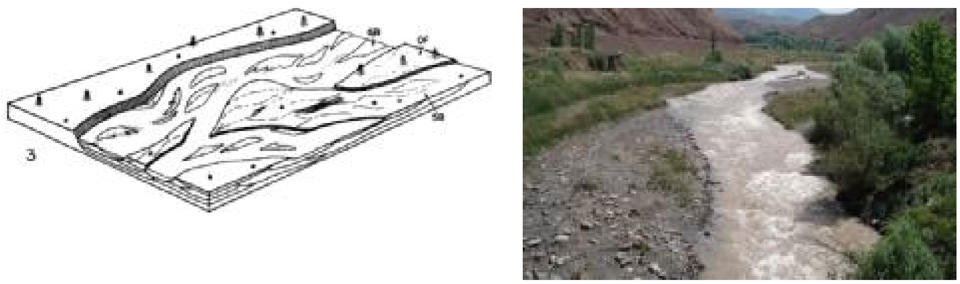

Fig. 1: major gravelly, low-sinuosity river with well-defined topographic levels.

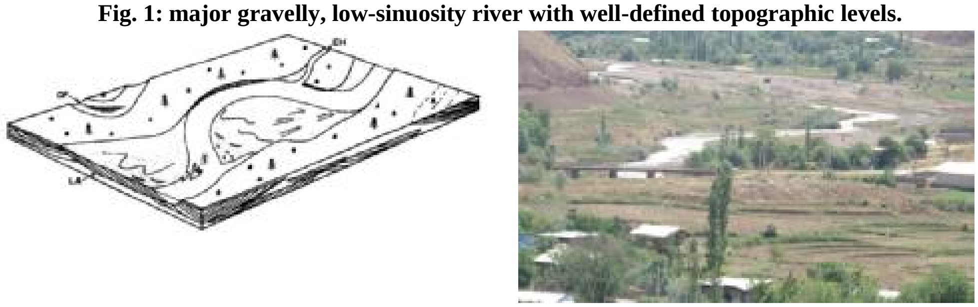

Fig. 2: gravelly, high-sinuosity river.

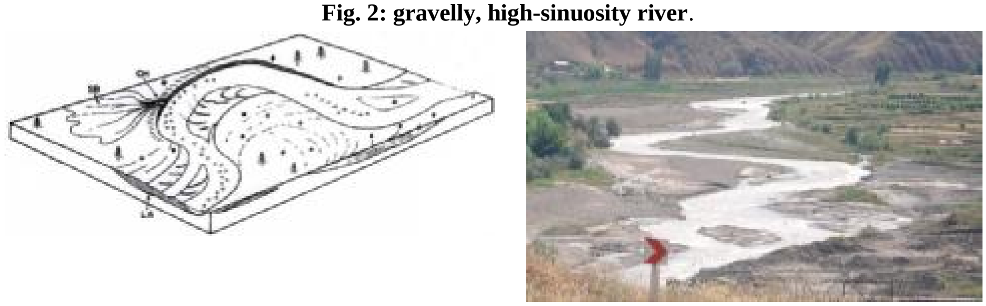

Fig. 3: sand- and pebbly sand-bed "coarse-grained meandering" river.

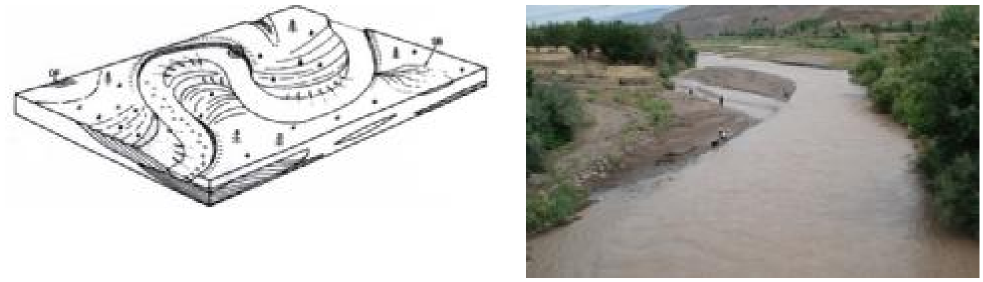

Fig. 4: the classic sandy, mixed-load meandering river.

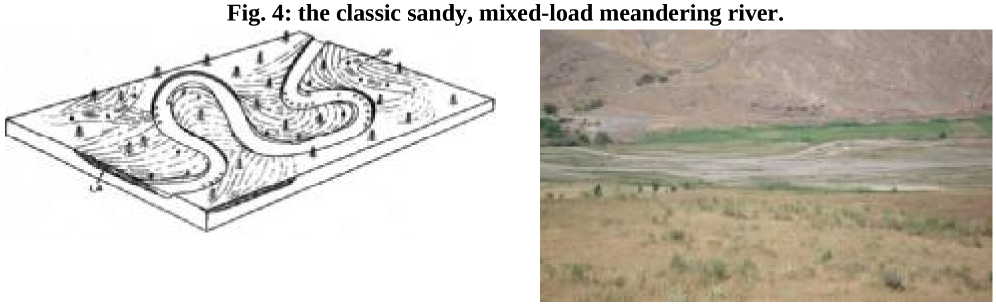

Fig. 5: muddy, fine-grained meandering river.

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