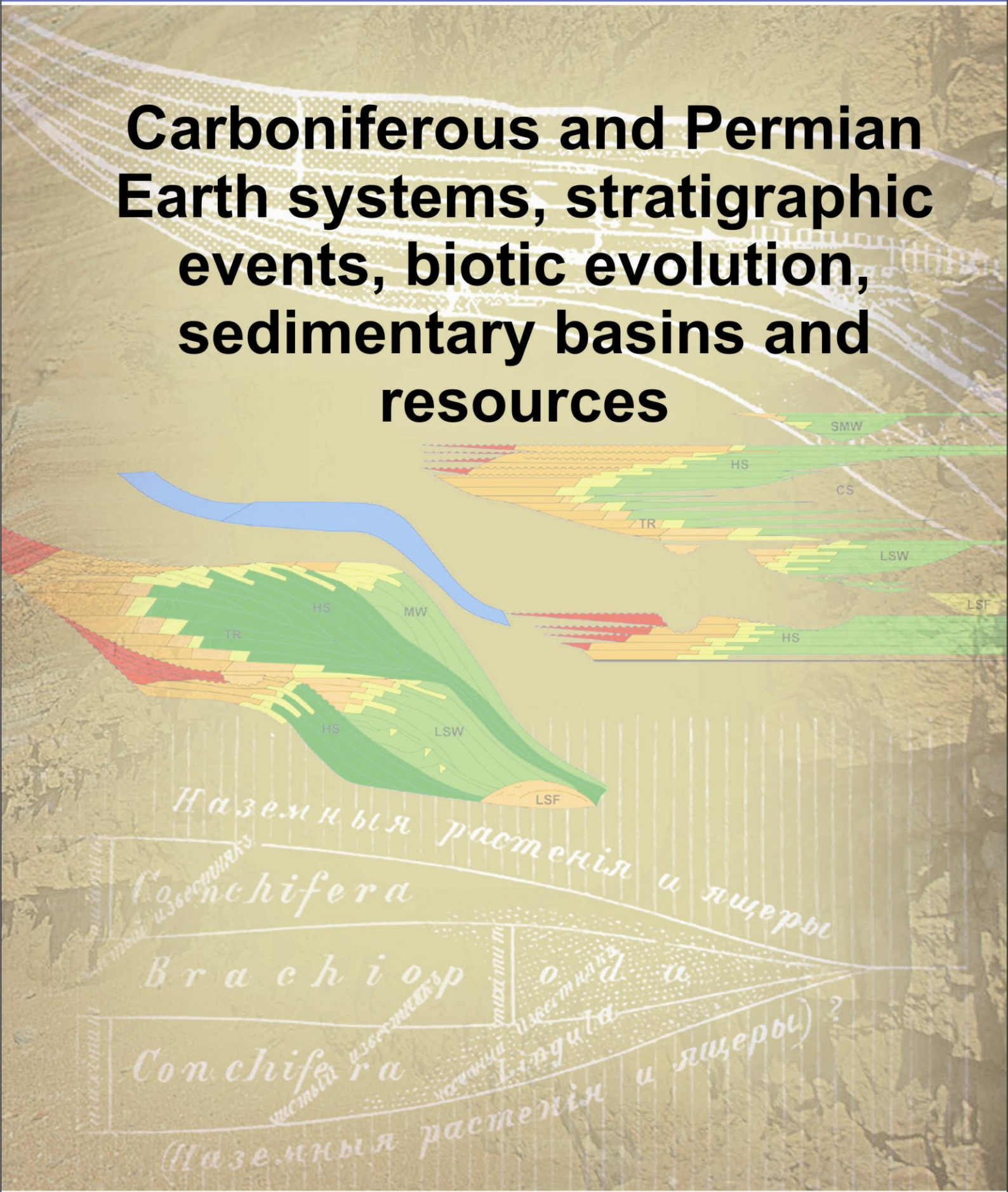
Kazan Golovkinsky Stratigraphic Meeting
2014

Kazan Federal University
Institute of Geology and Petroleum Technologies

Carboniferous and Permian Earth systems, stratigraphic events, biotic evolution, sedimentary basins and resources



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Reconstruction of sedimentary conditions of Middle Permian Kama-Ural basin studied by N.A.Golovkinsky

Alexander Lalomov [1], Guy Berthault [2], Marina Tugarova [3], Viktor G. Isotov [4], Lyalya M. Sitdikova [4]

[1] Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, Russian Academy of Science IGEM RAS, Moscow, Russia
[2] International Association of Sedimentologists, France
[3] Saint-Petersburg State University, St-Petersburg, Russia
[4] Kazan Federal University, Kazan, Russia

Golovkinsky Law (also known in Europe as Walter's Law) is one of the fundamental regularities that characterize lithological and facial features of sedimentary formations. The essence of the Law is successive alternation of types and character of sedimentation processes in sedimentary basins according to changes of hydrodynamic and hydrochemistry of the sedimentation environment both in a lateral and vertical direction. N. Golovkinsky provided the conclusions based upon research of a succession of sedimentary rocks in the Permian sequence of the valley of the Kama River [1].

Detail research of lithological structure, granulometric content and textural features of Middle Permian strata of Ural-Kama basin allows providing reconstruction of paleohydraulic conditions of sedimentation. Obtained data gave quantity illustration of Golovkinsky law of facial substitution.

Researched area mainly belongs to zone of development of sedimentation basin of Middle Permian age. Sustainable negative tectonic movements had beginning westward of Ural Folded System in Middle Permian and reached maximal expansion in Kazan time. Consecutive change of facies forms mainly terrigeneous deposits in the east part and carbonate-clay, carbonate and carbonate-sulphate sequence in the west. In the zone of interrelations, it was complicated with shallow-sea lens-shape bodies of sandstones and conglomerates fixed geodinamically active structures of Tatar Arch, which divide the basin to terrigeneous (east) and mostly clay-carbonate-sulphate (west) parts. The Kazan sequence consists of two series: transgressive Lower Kazan and regressive Upper Kazan [2].

Analysis of paleoflows based on research of structures and textures of Kazan stage sediments allows revealing of paleohydraulic conditions in the sedimentary basin.

Diagram of Rubin and McCulloch (1980) allows estimation of the flow velocity by parameters of cross-beds; the same data are possible to receive from granulometric composition using Hjulstrom diagram (Hjulstrom, 1935). The directions of the flows were obtained from rose-diagram of cross-beds.

Whereas in the continental pre-Ural part velocity of the flows orientated mainly from east to west reached 1.8 m/s in the beginning of transgression and decreased to 0.2-0.8 m/s in the end of regression stage, the situation in the marine part was much more complicated.

In the western (carbonate) basin the velocities varied from 0.2 m/s in the beginning of transgression to zero in the upper point.

In the area of Tatar Arch during Ufa Stage the paleoflows had south and south-east directions and were orientated parallel to the coastline of paleobasin. Paleoflows of north-west to south-west prevailed in the Early Kazan Age.

The structure of paleoflows cardinally changed in Later Kazan Age. In the north part of Tatar Arch south-west directions of paleoflows had been prevailed. In the south part both south-east and south-west paleoflows are revealed, that is concerning with moderate development of Tatar Arch structures. Velocities of the currents in the Arch zone reached 1.8 v/s.

Facial interrelations in the zone of Tatar Arch and western basin were researched in detail by joint group of Kazan Ubiversity, Saint-Petersburg University and IGEM RAS. In the westward direction facial transition from coarse terrigeneous sediments (sandstones with pebbles) through siltstones and argillites to carbonate-gypsum sequence is observed. As the transgression developed, facial zones shifted after the coastline; therefore, coarser sediments had been overlay by finer ones.

For example, lower part of Early Kazan sequence near the axis of Tatar Arch (Elabuga – Krasny Bor) is represented by sandstones with pebbles of argillites up to 3-5 cm. Westward in the mouth of Vyatka the deposits are laterally changed into sandstone-siltstone-argillite strata. Far to the west the terrigeneous deposits change to carbonates. At the same time, in vertical direction sandstones changed to siltstones, argillites – to carbonates and carbonates – to carbonate-gypsum lowers consequently. The transgression sequence in the facial interrelations area of Tatar Arch is complicated by consedimentation tectonic movements.

Thus, observed lithological lowers are not corresponds to a single time interval, but belongs to different sliding geochronological divisions. The sedimentary genesis of the sequence is explained by simultaneous prograding of the strata both laterally and vertically and movement of facial zoning during transgression and regression cycles.

This explanation does not corresponds to the classical Stenon stratigraphic concept of successive horizontal layers, but agree with Golovkinsky law which become foundation of sequence stratigraphy.

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We thank the attendees of the Kazan Golovkinsky Stratigraphic Meeting, 2014 for join us

Alexander S.	Alekseev	aaleks@geol.msu.ru
Mikhail P.	Arefjev	mike.p.arefjev@gmail.com
Maryamnaz	Bahrammanesh Tehrani	bahrammanesh69@gmail.com
Yuriy P.	Balabanov	balabanov-geo@mail.ru
Georgii	Batalin	batalinga@yandex.ru
Guy	Berthault	berthault.guy@orange.fr
Alexander S.	Biakov	abiakov@mail.ru
Elena	Bobrova	prosto.1992@mail.ru
Valeriy V.	Bulanov	bulanov@paleo.ru
Vladimir I.	Davydov	vdavydov@boisestate.edu
Vladimir	Dzhun	dzhun34@bk.ru
Daniel	Falk	daniel.falk.email@gmail.com
Danil	Garaev	garaev.d.v@gmail.com
Bulat	Gareev	bulat@gareev.net
Shekhar	Ghosh	scghosh2001@yahoo.com
Annette E.	Goetz	a.gotz@ru.ac.za
Valeriy K.	Golubev	vg@paleo.ru
John	Hancox	hancox@cciconline.com
Natalia S.	Inkina	nsinkina@geo.komisc.ru
John	Isbell	jisbell@uwm.edu
Alexander O.	Ivanov	IvanovA-Paleo@yandex.ru
Viktor G.	Izotov	sitdikova8432@mail.ru
Pavel B.	Kabanov	kabanovp@gmail.com
Rinat R.	Khassanov	Rinat.Khassanov@kpfu.ru
Rafael	Khousainov	Rafael.Khousainov@gmail.com
Olga L.	Kossovaya	olga_kossovaya@vsegei.ru
Galina V.	Kotlyar	Galina_Kotlyar@vsegei.ru
Julia V.	Kuznetzova	Julia.Kuznetzova@kpfu.ru
Abdelouahed	Lagnaoui	abdelouahedlagnaoui@gmail.com
Alexander	Lalomov	lalomov@mail.ru
Dinara N.	Miftahutdinova	dinyamift@gmail.com
Georgy	Mirantsev	gmirantsev@gmail.com
Iya I.	Molostovskaya	MolostI@yandex.ru
Vladimir P.	Morozov	Vladimir.Morozov@kpfu.ru
Fedor A.	Mouraviev	fedor.mouraviev@yandex.ru
Serge V.	Naugolnykh	naugolnykh@list.ru
Svetlana N.	Nikolaeva	44svnikol@mail.ru
Danis K.	Nurgaliev	Danis.Nourgaliev@kpfu.ru

Nouria G.	Nurgalieva	nurgal07@mail.ru
Galina Yu.	Ponomareva	galina@tiron.ru
Svetlana T.	Remizova	stremizova@yandex.ru
Katrin	Ruckwied	katrin.ruckwied@shell.com
Viktor A.	Saldin	litgeo@geo.komisc.ru
Joerg W.	Schneider	Joerg.Schneider@geo.tu-freiberg.de
Frank	Scholze	frank.scholze@geo.tu-freiberg.de
Andrey G.	Sennikov	sennikov@paleo.ru
Vladimir	Shpikerman	vladimir_shpikerman@vsegei.ru
Vladimir V.	Silantiev	Vladimir.Silantiev@kpfu.ru
Lyalya M.	Sitdikova	sitdikova8432@mail.ru
Evgeny O.	Statsenko	e.statsenko@yahoo.com
Rafael Kh.	Sungatullin	Rafael,Sungatullin@kpfu.ru
Guzel M.	Sungatullina	Guzel.Sungatullina@kpfu.ru
Alexander	Trifonov	blast_88@mail.ru
Marina	Tuganova	tugarova@mail.ru
Milyausha N.	Urazaeva	Milyausha.Urazaeva@kpfu.ru
Maria A.	Zhokina	m.zhokina@mail.ru
Irina P.	Zinatullina	izinatul@yandex.ru
Svetlana O.	Zorina	svzorina@yandex.ru

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тел. (843) 233-73-59, 233-73-28