

PS Granitoid Magmatism in Tectonic Evolution of Arctic Continental Margin of Chukotka*

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Search and Discovery Article #30301 (2013)**
Posted December 3, 2013

*Adapted from a poster presentation given at AAPG 3P Arctic Polar Petroleum Potential Conference & Exhibition, Stavanger, Norway, October 15-18, 2013

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Abstract

Arctic continental margin of Chukotka formed as a result of collision between Chukotka microcontinent (Anuyi-Chukotka fold system) and structures of Siberian active margin (Alasey-Oloy fold system). Closure of oceanic space was followed by South-Anyui suture formation. Anuyi-Chukotka fold system (ACFS) includes ancient Precambrian basement and intensively deformed Paleozoic-Mesozoic sedimentary cover. ACFS is composed of several terranes or subterranea: Vrangel, Anuyi, Chauna, and Bering, which have distinct stratigraphical, lithological and structural differences. Basement and cover are intruded by numerous granitoid intrusions, which earlier were subdivided into Early Cretaceous (collisional) and Late Cretaceous, related to Okhotsk-Chukotka volcanic belt formation. Last year's new data, indicating repeated intrusions of granitoid in geological evolution of Arctic margin of Chukotka, appeared (Natal'in et al., 1999; Katkov et al., 2007; Miller et al., 2009; Tikhomirov et al., 2011; Luchitskaya et al., 2012; Akinin, 2011; Akinin et al., 2012). Thus, following stages of granitoid magmatism may be distinguished: (1) 609–677 Ma (Kos'ko et al., 1993), 650–550 Ma (Natal'in et al., 1999), 580–650 Ma (Akinin, 2011); (2) 375–369 Ma (Natal'in et al., 1999), 380–360 Ma (Akinin et al., 2012) and 352, 353 Ma (Luchitskaya et al., 2013); (3) 142–145 Ma (Akinin et al., 2012), 135 Ma (Luchitskaya et al., 2012), Valanginian-Hauterivian (Zhulanova et al., 2007); (4) 127–100 Ma (Katkov et al., 2007; Miller et al., 2009; Tikhomirov et al., 2011; Akinin et al., 2012); and (5) 100–77 Ma. Neoproterozoic stage is related to formation of crystalline basement of Chukotka microcontinent. Paleozoic stage is correlated to Ellesmerian orogeny and indicates similarity to terranes of Arctic Alaska. Detrite zircons of this age are typical for Triassic sandstones of Chukotka (Miller et al., 2006). Origin of third stage granitoid magmatism is problematic. Its age correlates to intensive closure of South-Anyui oceanic basin and syncollisional stage. Possible intrusion of granitoids resulted from destruction and thickening of subducting continental lithosphere of Chukotka microcontinent. Forth stage corresponds to postcollisional extension, formation of granite-metamorphic core complexes and overlapping basins (onshore – Aynakhkurgan, Nutesyn et al.) and offshore – South-Chukotka trough). Fifth stage correlates to formation of Andean type margin (Okhotsk-Chukotka volcanic belt). At the same time one granitoids were directly related to volcanic series formation, others may intrude as dikes and small intrusions in the back-arc of Andean margin. Work was supported by RFBR projects 13-05-00249, 11-05-00074, scientific school # NSh-5177.2012.5, Programme ONZ 10.

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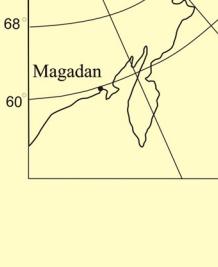
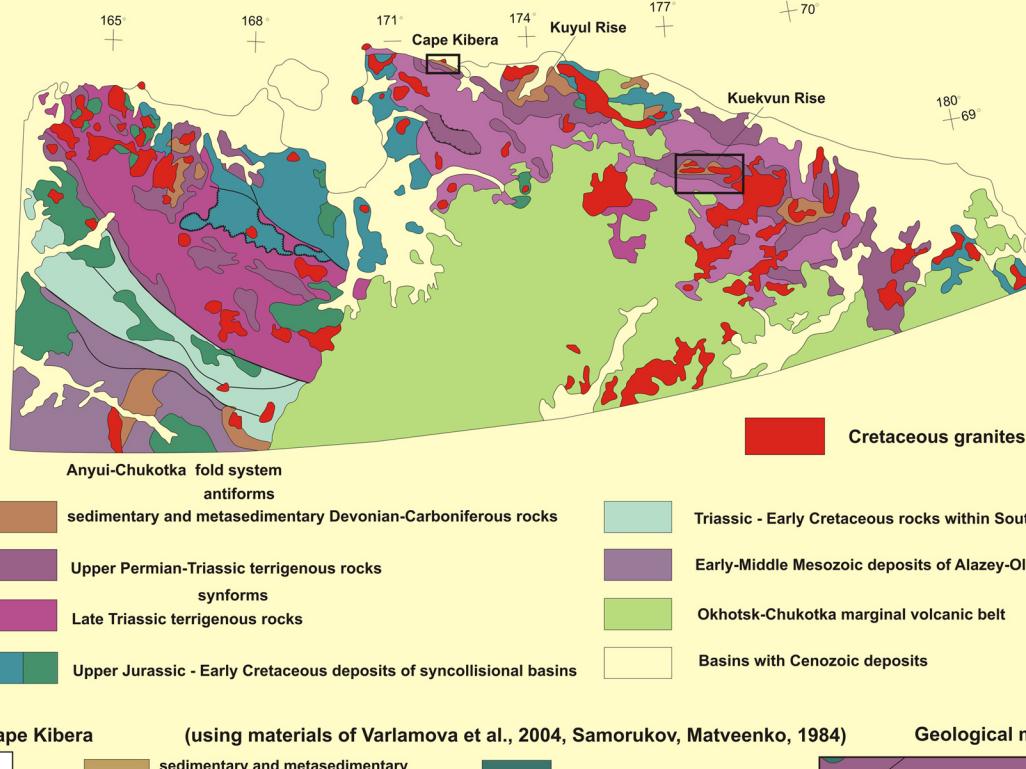
Basement and cover are intruded by numerous granitoid intrusions, which earlier were subdivided into Early Cretaceous (collisional) and Late Cretaceous, related to Okhotsk-Chukotka volcanic belt formation.

Last year's new data, indicating repeated intrusions of granitoids in geological evolution of Arctic margin of Chukotka, appeared (Natal'in et al., 1999; Katkov et al., 2007; Miller et al., 2009; Tikhomirov et al., 2011; Luchitskaya et al., 2012; Akinin, 2011; Akinin et al., 2012).

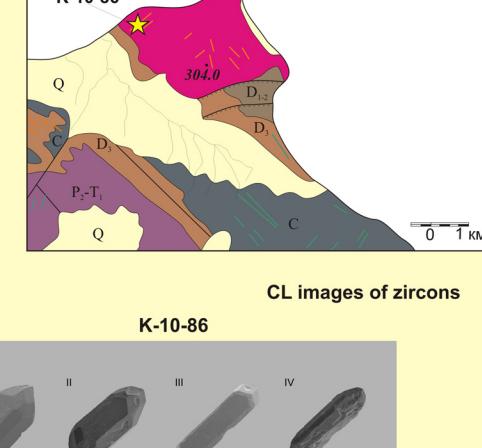
Thus, following stages of granitoid magmatism may be distinguished: (1) 609–677 Ma (Kos'ko et al., 1993), 650–550 Ma (Natal'in et al., 1999), 580–650 Ma (600–630 Ma – inherited cores) (Akinin, 2011; Akinin et al., 2012); (2) 375–369 Ma (Natal'in et al., 1999), 380–360 Ma (Akinin et al., 2011) and 352, 353 Ma (Luchitskaya et al., 2013); (3) 142–145 Ma (Akinin et al., 2012), 135 Ma (Luchitskaya et al., 2012), Valanginian-Hauterivian (Zhulanova et al., 2007); (4) 127–100 Ma (Katkov et al., 2007; Miller et al., 2009; Tikhomirov et al., 2011; Akinin et al., 2012); and (5) 100–77 Ma.

Late Paleozoic (Ellesmerian) stage of granitoid magmatism

Geological map of Central Chukotka (modified after Tibilov, Cherepanova, 2001)



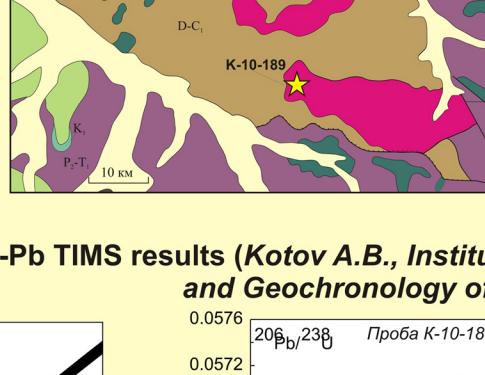
Geological map of Cape Kibera



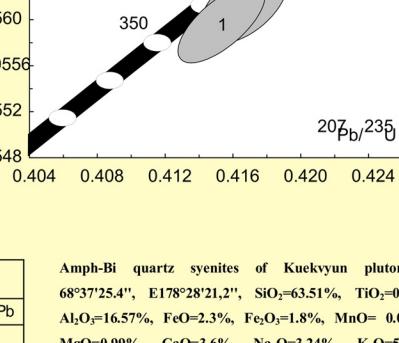
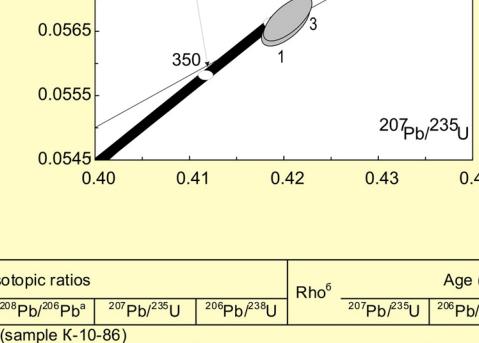
(using materials of Varlamova et al., 2004, Samorukov, Matveenko, 1984)



Geological map of Kuekun Rise



Geochronological U-Pb TIMS results (Kotov A.B., Institute of Geology and Geochemistry of Precambrian)

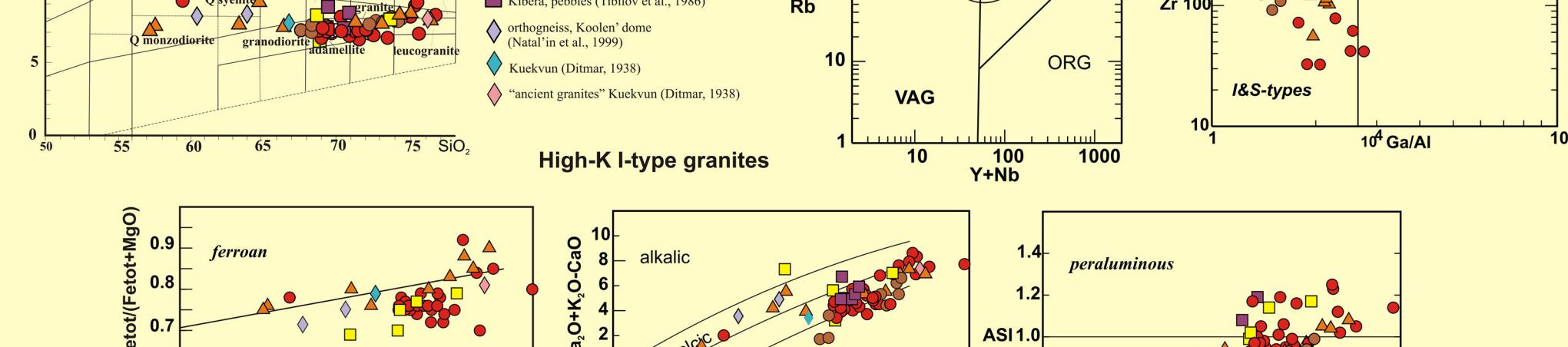


Granodiorites of Kibera pluton ($N = 69^{\circ}56' 50.5''$, $E = 172^{\circ}40' 52.1''$; $SiO_2 = 67.34\%$, $TiO_2 = 0.41\%$, $Al_2O_3 = 14.72\%$, $FeO = 2.66\%$, $Fe_{2O_3} = 1.88\%$, $MnO = 0.074\%$, $MgO = 1.4\%$, $CaO = 2.48\%$, $Na_2O = 3.71\%$, $K_2O = 3.42\%$, $P_2O_5 = 0.232\%$) have foliated texture, blastogranitic structure and are composed of quartz, plagioclase, potassio feldspar and biotite. Accessory minerals are sphene, allanite, apatite and zircon.

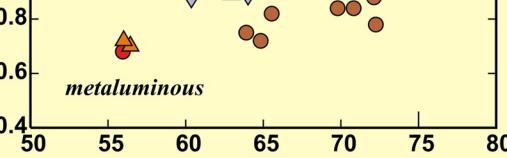
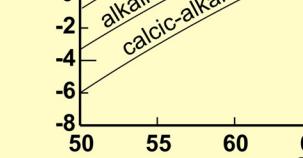
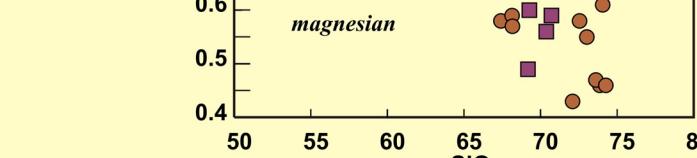
Fraction (micrometer) and its characteristics	Hanging (milligram)	Content (mkr/g)	Isotopic ratios				Rho^6	Age (ma)	
			$^{206}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$	$^{207}Pb/^{235}U$			
Biotite granodiorite (sample K-1086)			0.0538±1	0.2112±1	0.4201±9	0.0566±1	0.64	356±1	355±1
	85-100, 15 gr.	0.17	45.6	714	1292				364±4
	100-150, 15 grp.	0.23	58.5	836	412	0.0543±1	0.1840±1	0.4293±7	363±1
	85-100, 10 gr.	0.22	26.7	414	1016	0.0558±1	0.2102±8	0.0574±1	360±1
								0.78	382±2
								0.68	356±1
									355±1
									362±3
Amphibole-biotite quartz syenite Kuekun pluton (sample K-10189)			0.0538±1	0.1930±1	0.4153±8	0.0560±2	0.70	353±1	351±1
	85-100, 15 gr.	0.15	57.8	945	2265				364±3
	>100, 13 gr.	0.11	60.0	935	816	0.0538±1	0.1973±1	0.4167±12	354±1
								0.53	352±1
									364±5

Amph-Bi quartz syenites of Kuekun pluton ($N = 68^{\circ}37'25.4''$, $E = 178^{\circ}28'21.2''$; $SiO_2 = 63.51\%$, $TiO_2 = 0.40\%$, $Al_2O_3 = 16.57\%$, $FeO = 1.8\%$, $MnO = 0.056\%$, $MgO = 0.99\%$, $CaO = 3.6\%$, $Na_2O = 3.24\%$, $K_2O = 5.83\%$, $P_2O_5 = 0.245\%$) also have foliated texture, blastohypidiomorphic structure and are composed of plagioclase, potassio feldspar, amphibole, biotite and quartz. Sphene prevails within accessory minerals, allanite, apatite and zircon are also present.

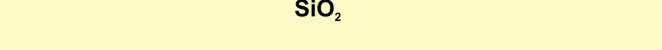
Petro-geochemical features of granites



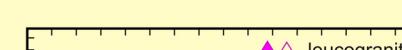
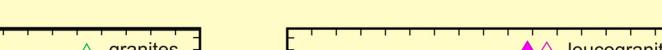
High-K I-type granites



REE's Kibera



REE's Kuekun



REE's Kibera, pebbles



Spidergrams Kibera



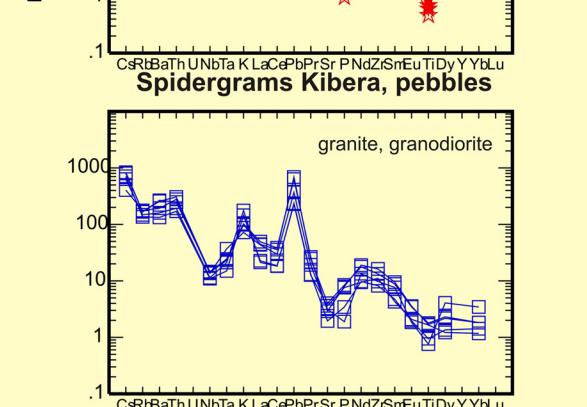
Spidergrams Kibera



Conclusions

Neoproterozoic stage is related to formation of crystalline basement of Chukotka microcontinent. Paleozoic stage is correlated to Ellesmerian orogeny and indicates similarity to terranes of Arctic Alaska. Detrite zircons of this age are typical for Triassic sandstones of Chukotka (Miller et al., 2006). Origin of third stage granitoid magmatism is problematic. Its age correlates to intensive closure of South-Anuyi oceanic basin and synollisional stage. Possibly intrusion of granitoids resulted from destruction and thickening of subducting continental lithosphere of Chukotka microcontinent. Fourth stage corresponds to postcollisional extension, formation of granite-metamorphic core complexes and overlapping basins (onshore – Aynakhkuren, Nutesyn et al.) and offshore – South-Chukotka trough. Fifth stage correlates to formation of Andean type margin (Okhotsk-Chukotka volcanic belt). At the same time one granitoids were directly related to volcanic series formation, others may intrude as dikes and small intrusions in the back-arc of Andean margin.

Spidergrams Kuekun



Spidergrams Kibera, pebbles

