[PS]Paleomagnetic Study of Mesozoic Sediments of the New Siberian Islands: Remagnetization Caused by Collision with Siberia?*

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Abstract

The New Siberian Islands (NSI) terrane is a large tectonic structure with a Precambrian basement and a Phanerozoic sedimentary cover which is exposed on the several groups of archipelagoes in the East Siberian and Laptev seas. Its Paleozoic and Mesozoic tectonic history is actively discussed in the scientific community. Thus, there are still some debates about the relationships of some continental blocks in the Verkhoyansk-Chukotka orogenic area forming (Kolyma-Omolon, NSI and Chukotka-Alaska terranes, Siberia) and, consequently, about the continuation of the South Anyui suture on the Arctic shelf and Amerasian basin opening scenarios. According to most opinions this suture presents a main tectonic boundary between the Alaska-Chukotka and NSI terranes (or one composite terrane?) and the Eurasia, and its age is defined as Late Jurassic – Early Cretaceous. During field trips to the NSI in 2011 the Upper Jurassic – Lower Cretaceous clastic sediments of Stolbovoy Is. and Great Lyakhovsky Is. were sampled for paleomagnetic study. These rocks are believed to have accumulated in the foretrough during the Anyui orogeny. Also, Triassic siltstones from the Kotelny Island were tested. The regular paleomagnetic directions for these sites were obtained by stepwise demagnetization and Zijderveld diagrams analysis. The synchronicity of determined magnetization and rock formation was verified by fold test which appeared to be negative, indicating a post-folding age of this magnetization. To estimate the age of the expected remagnetization we compared the poles calculated from directions in geographic coordinates with the Mesozoic interval of the Siberian APWP. It revealed that the obtained NSI terrane poles match with its 140-80 Ma interval within the error limits and the age of remagnetization increases to the south of archipelago. Studied sites are located close to the southern and western boundary of NSI terrane. The previous studies of Lower Paleozoic rocks sampled away from a boundary proved the preservation of primary magnetization. So we can assume that this remagnetization of sediments of the NSI terrane is local and took place mostly along its southwestern boundary. It is synchronous with the end of accretion-collisional processes associated with the attaching of the NSI terrane to Siberia. The different age of remagnetization in various parts of the archipelago can be explained by anticlockwise rotation of the terrane relative to Siberia.

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Abstract

The New Siberian Islands (NSI) terrane is a large tectonic structure with a Precambrian basement and a Phanerozoic sedimentary cover which is exposed on the several groups of archipelagoes in the East Siberian and Laptev seas. Its Paleozoic and Mesozoic tectonic history is actively discussed in the scientific community. Thus, there are still some debates about the relationships of some continental blocks in the Verkhoyansk-Chukotka orogenic area forming (Kolyma-Omolon, NSI and Chukotka-Alaska terranes, Siberia) and, consequently, about the continuation of the South Anyui suture on the Arctic shelf and Amerasian basin opening scenarios. According to most opinions this suture presents a main tectonic boundary between the Alaska-Chukotka and NSI terranes (or one composite terrane?) and the Eurasia, and its age is defined as Late Jurassic – Early Cretaceous. During field trips to the NSI in 2011 the Upper Jurassic – Lower Cretaceous clastic sediments of Stolbovoy Is. and Great Lyakhovsky Is. were sampled for paleomagnetic study. These rocks are believed to have accumulated in the foretrough during the Anyui orogeny. Also, Triassic siltstones from the Kotelny Is. were tested. The regular paleomagnetic directions for these sites were obtained by stepwise demagnetization and Zijderveld diagrams analysis. The synchronicity of determined magnetization and rock formation was verified by fold test which appeared to be negative, indicating a post-folding age of this magnetization. To estimate the age of the expected remagnetization we compared the poles calculated from directions in geographic coordinates with the Mesozoic interval of the Siberian APWP. It revealed that the obtained NSI terrane poles match with its 140-80 Ma interval within the error limits and the age of remagnetization increases to the south of archipelago. Studied sites are located close to the southern and western boundary of NSI terrane. The previous studies of Lower Paleozoic rocks sampled away from a boundary proved the preservation of primary magnetization. So we can assume that this remagnetization of sediments of the NSI terrane is local and took place mostly along its southwestern boundary. It is synchronous with the end of accretion-collisional processes associated with the attaching of the NSI terrane to Siberia. The different age of remagnetization in various parts of the archipelago can be explained by anticlockwise rotation of the terrane relative to Siberia.

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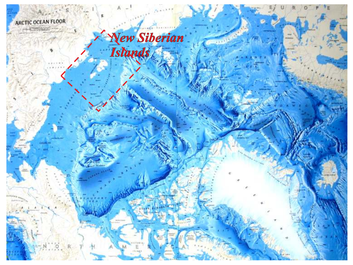
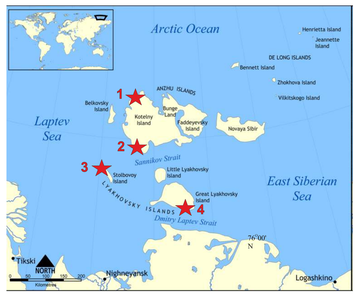
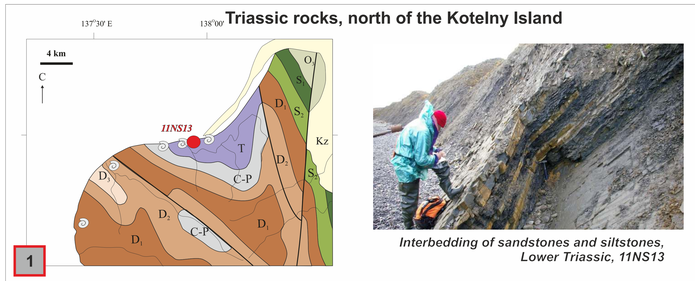




The New Siberian Islands (NSI) are situated on the Arctic shelf and consist of the archipelagos of Lyakhovsky, Anjou and De Long Islands. The paleomagnetic collections of Devonian and Mezozoic rocks were sampled in 2011 and 2013 during international expeditions and the red stars show the location of the sampling sites. The numbers correspond to the numbers on the geological maps on the right and below.

Objects location and paleomagnetism



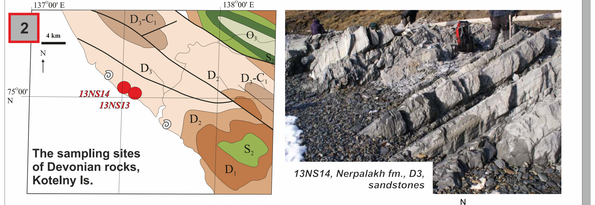
The results of stepwise demagnetization of NRM (natural remanent magnetization): orthogonal diagrams and stereograms.

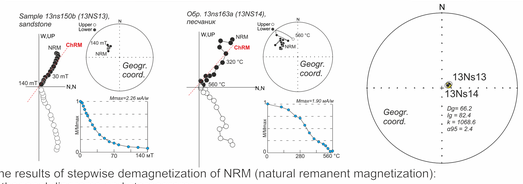
Table. Paleomagnetic data from Devonian and Mezozoic sedimentary rocks of the New Siberian Islands

No	Sampling site, rock, age	n/N	Geogr. coord.		Strat. coord.		K	α_{95}	VGPole(°)			Plat(°)
			D (°)	I (°)	D (°)	I (°)			PLat	PLong	dp/dm	
Kotelny Island												
1	13ns13, sandstone, nerpalakh fm., D3	12/12	66,7	82,9	299,6	54,8	211,7	3,1	74,0	192,1	6,1/5,9	76,0
2	13ns14, sandstone, nerpalakh fm., D3	10/10	65,7	81,8	278,3	60,2	171,3	3,7	73,2	198,8	7,2/7,0	73,9
	Mean. nerpalakh fm., D3		66,2	82,4	-	-	207,2	2,2	-	-	-	-
			-	-	290,7	57,7	91	3,3	-	-	-	-
3	11ns13, sandstone, T1	14/14	35,1	83,8	30,70	41,8	40.8	6,3	82,0	198,7	12,4/12,2	77,7
Stolbovoi Island												
4	11ns15, sandstone, J3-K1	15/15	331.8	80,8	19,4	59,9	55,0	5,2	81,6	44,5	10,0/9,7	72,1
5	11ns16, sandstone, J3-K1	8/12	337,4	78,7	37,1	63,8	39,7	8,9	80,7	17,1	16,9/16,0	68,2
6	11ns17, sandstone, J3-K1	9/10	9,8	64,4	50,5	7,4	24,1	10,7	61,7	301,0	17,1/13,7	46,2
	Mean, stolbovskoy unit, J3-K1		346,6	72,5	-	-	54,4	16,9	-	-	-	-
			-	-	39,6	46,5	5,7	57,1	-	-	-	-
Big Lyakhov Island												
7	11ns14, sandstone, burustass fm., J3-K1	8/13	*132,9*	*87,5*	180,0	60,4	38,8	9,0	69,5	153,4	17,9/17,9	85,0

Note: n/N - number of samples, D and I – paleomagnetic declination and inclination, k – precision parameter, α95 – radius of the 95% confidence oval, Plat – pole latitude, Plong – pole longitude, dp/dm – values of the half-axes of the confidence oval for the pole, PL – paleolatitude for the site.

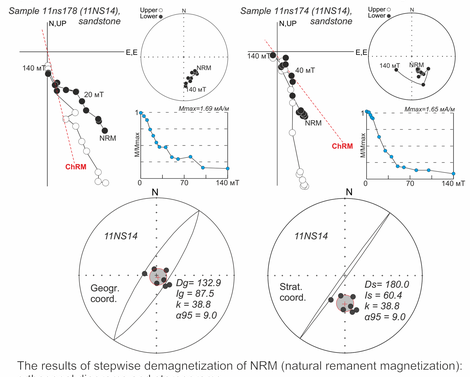
Upper Devonian rocks, Kotelny Island





The results of stepwise demagnetization of NRM (natural remanent magnetization): orthogonal diagrams and stereograms.

Upper Jurassic-Lower Cretaceous rocks, Great Lyakhov Island



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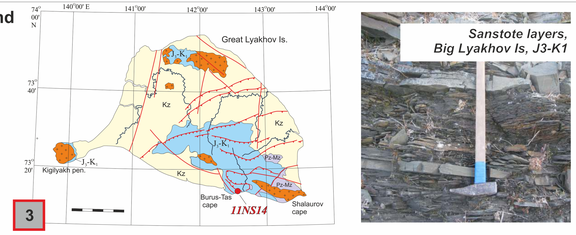
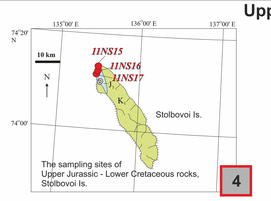
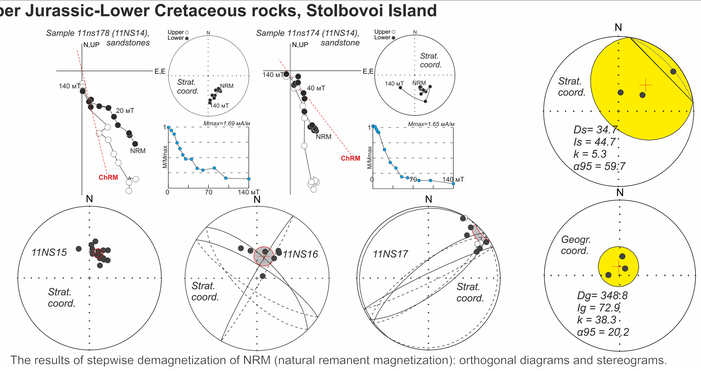


Upper Jurassic-Lower Cretaceous rocks, Stolbovoi Island





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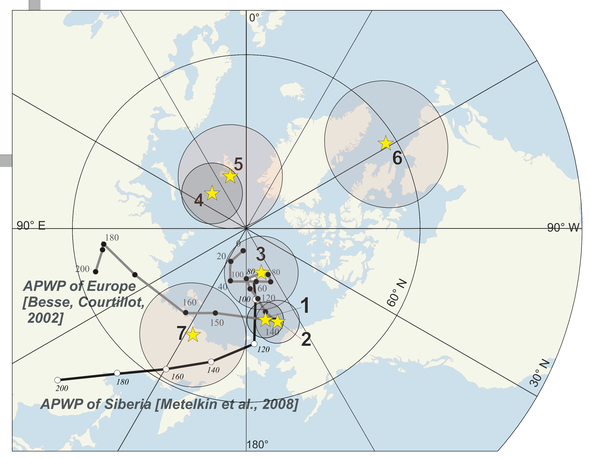
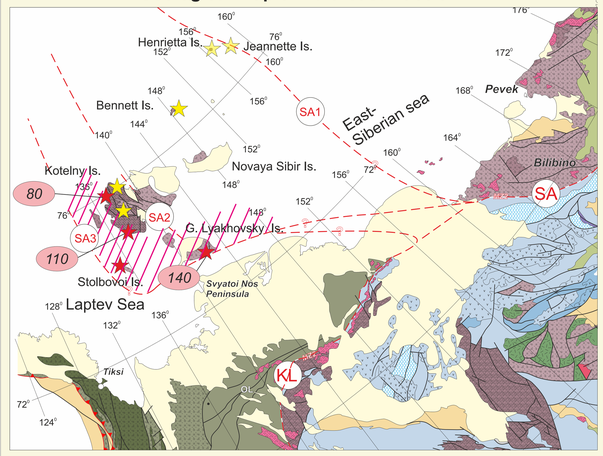


The calculated virtual magnetic poles for the obtained directions of magnetizaion in geographic coordinates in comparison with the Apparent Pole Wander Path (APWP) of Siberia [Metelkin et al., 2010] and Europe [Besse, Courtillot, 2002]. The numbers near the poles (yellow stars) correspond to the index numbers in the table.

Area of Mezozoic remagnetizaion in the New Siberian Islands

Geological map of northeast Russia



COLORS AND PATTERNS

Basement of continents, microcontinents and cratonal terrane

PC

Siberian passive continental margin

PC-V V-PZ PZ-MZ

Passive continental margin terranes

PC-V V-PZ PZ-MZ

Overlap assemblages

MZ KZ

Accretionary wedge terrane including oceanic rocks

Active continental margin terranes (volcanic belt)

PZ MZ

Island arc terranes

PZ MZ

Collisional granites assemblages

MZ

Calc-alkaline basalt and andesite

Volcanic rocks of variable composition

Subduction granitoids

Terrigenous rocks of littoral shelf

Carbonate and carbonate -siliciclastic rocks of distal shelf

Flysch and turbidite

Molasse

Suture

Frontal thrusts

Thrusts

Other main faults

The area of expected Cretaceous remagnetizion is demonstrated on the map. We suppose it is caused by tectonic reasons such as collision with Siberia margin. This zone is showy with the parallel red lines. The red stars are the places with the studied paleomagnetic sites having evidences of remagnetization described in this work. The yellow stars are the location of previously studied rocks which preserved the primary magnetization that proved by different paleomagnetic tests in [Vernikovsky et al., 2013, Metelkin et al., 2016, Zhdanova et al., 2016, Matushkin et al., 2016, Chernova et al., 2017a,b]. The numbers in the ellipses are the supposed age of remagnetizion in Ma and the arrow demonstrates the possible direction of rotation of the NSI terrane during the collision with Siberia.

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