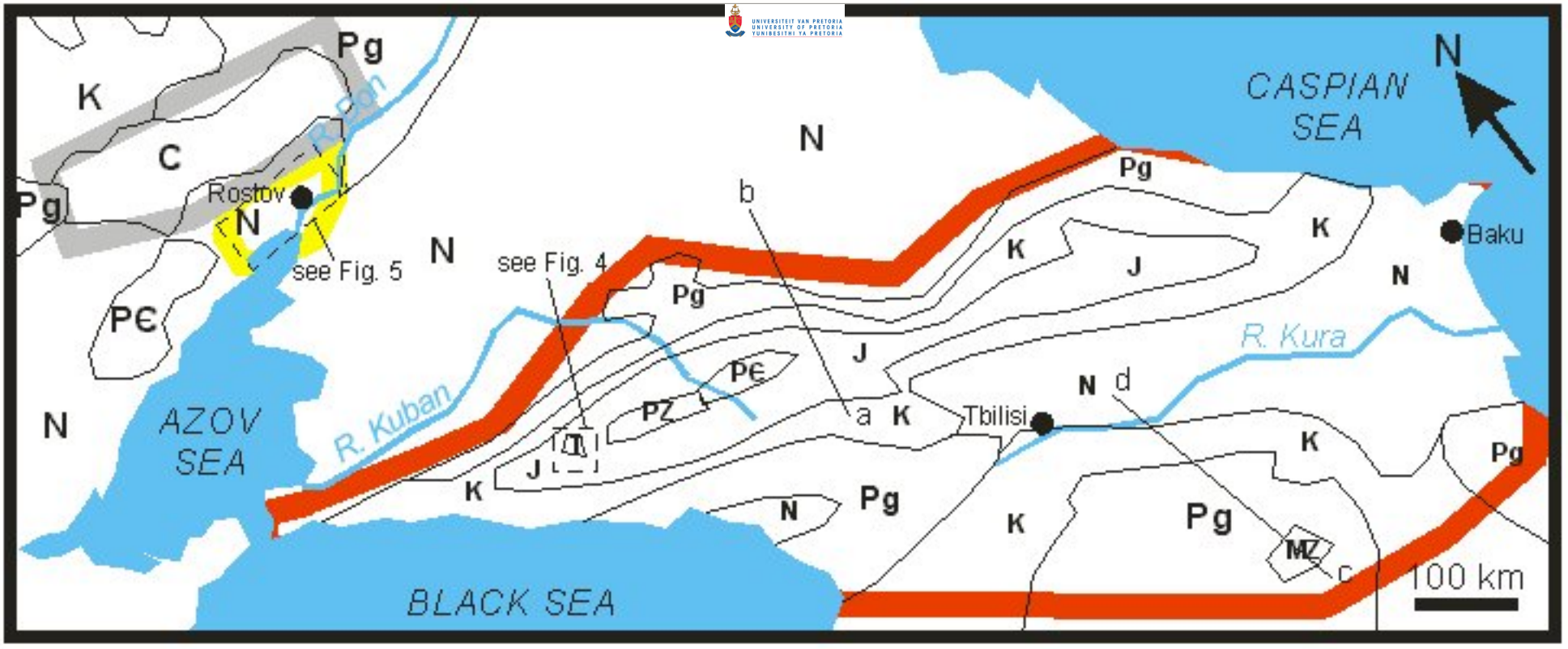


STUDIED REGIONS

- Caucasus
- Donbass
- Rostov Dome

Legend

AGE OF GEOLOGIC UNITS

N	Neogene
Pg	Paleogene
K	Cretaceous
J	Jurassic
T	Triassic
MZ	Mesozoic
PZ	Paleozoic
PC	Precambrian

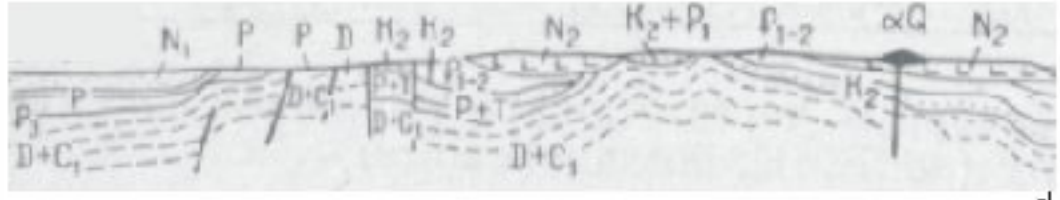
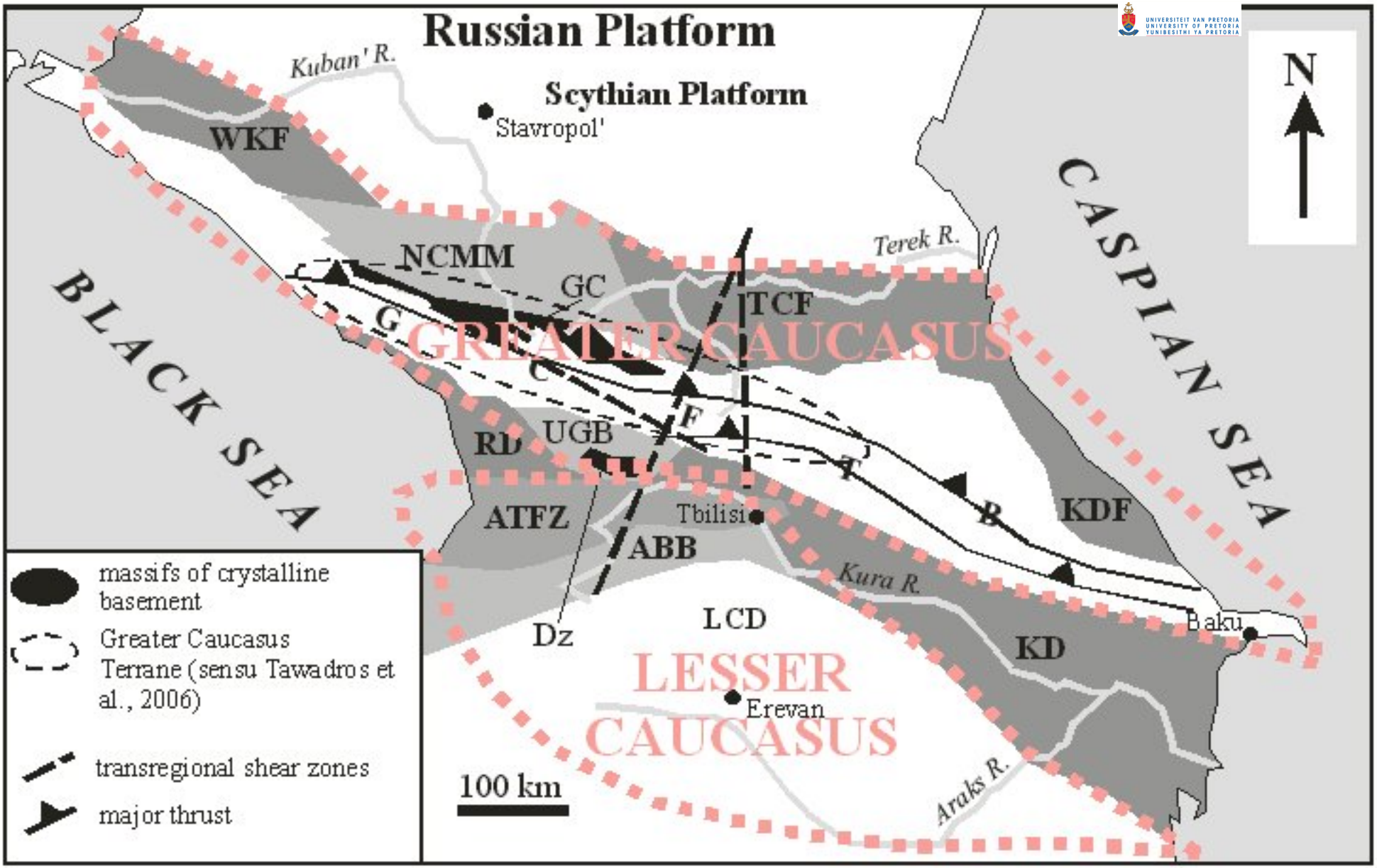
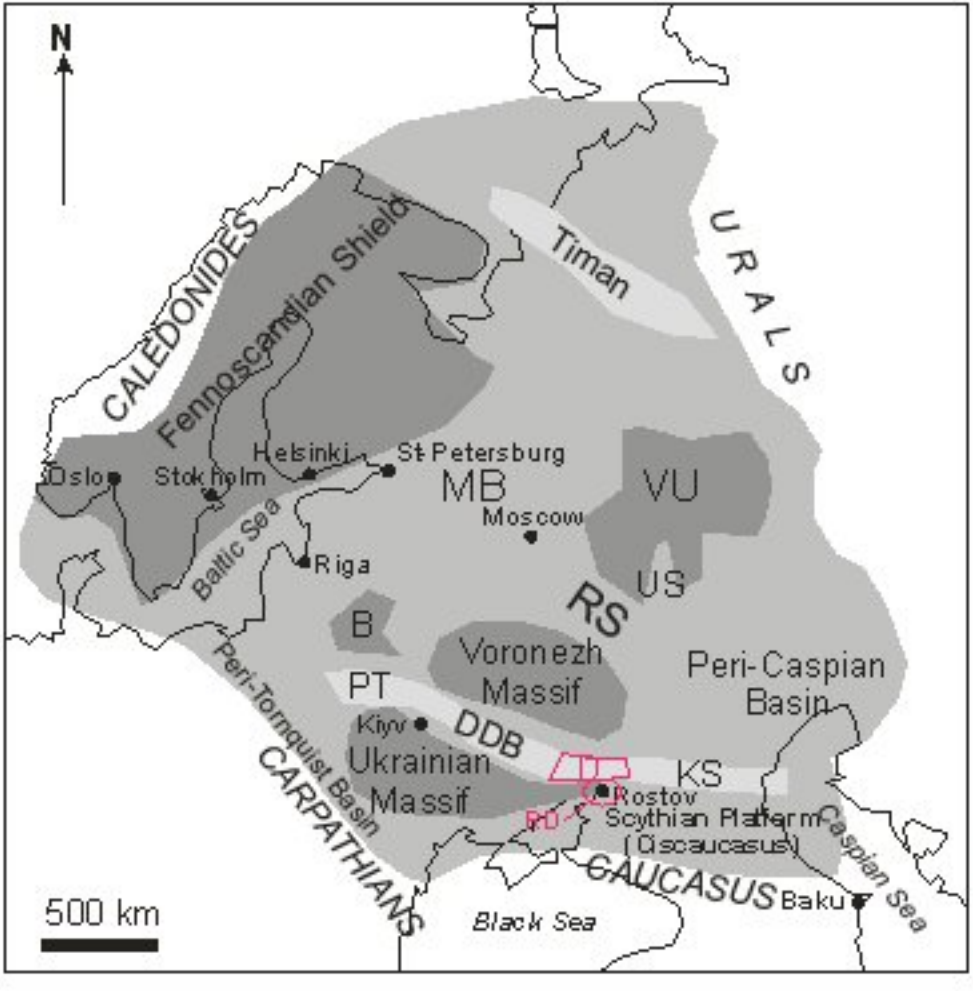


Figure 1. Geological map of the Caucasus and adjacent areas and a location of studied regions.



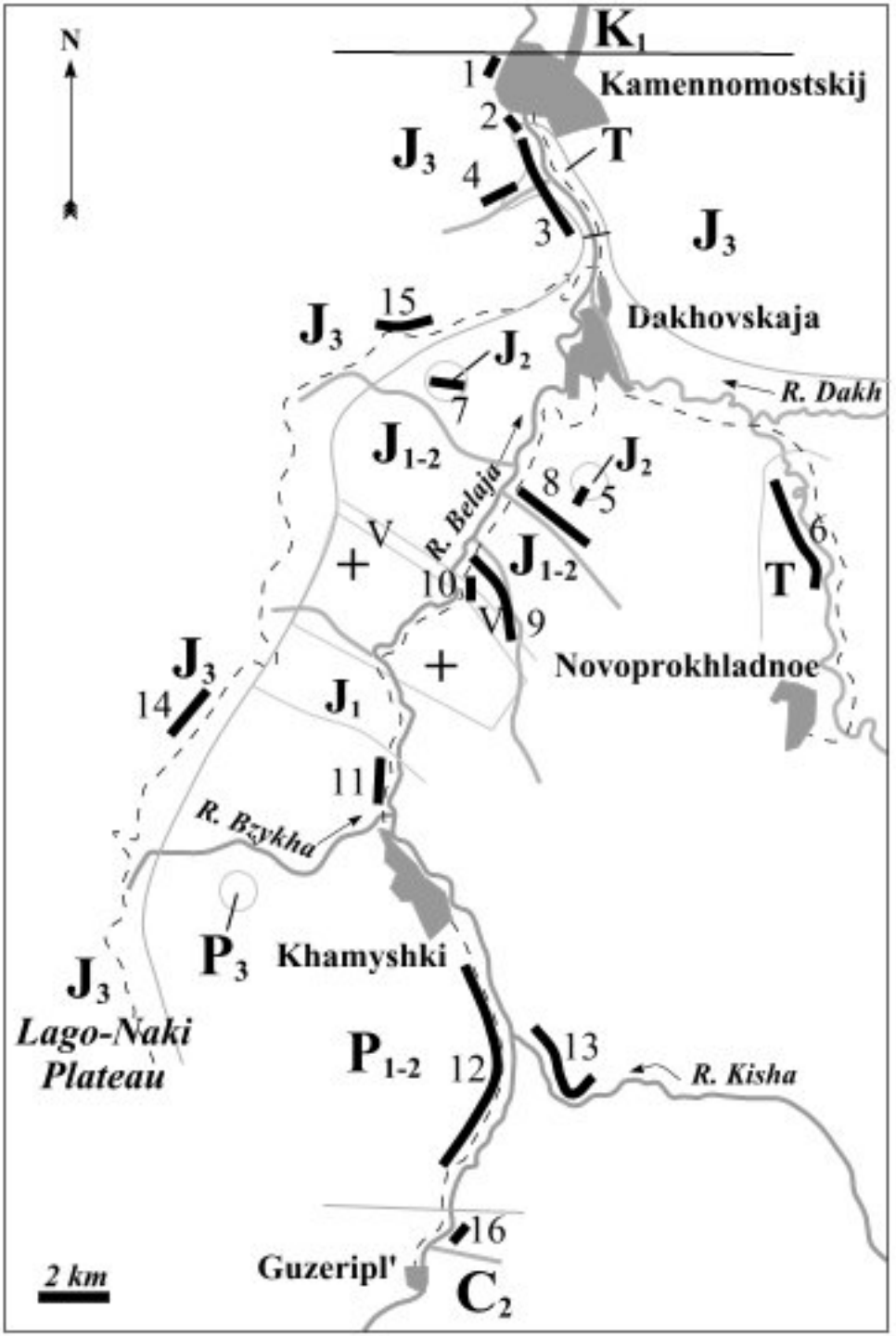
Abbreviations: ABB - Arthvin-Bolnisi Block, ATFZ - Adjara-Thrialethian Fold Zone, Dz - Dzirula Massif, GC - Greater Caucasian Massif, GCFTB - Greater Caucasian Fold and Thrust Belt, KD - Kura Depression, KDF - Kusar-Divichian Foredeep, LCD - Lesser Caucasus Domain, NCMM - North Caucasian Marginal Massif, RD - Rioni Depression, TCF - Terek-Caspian Foredeep, UGB - Uplifted Georgian Block, WKF - West Kubanian Foredeep. Different patterns are used to differentiate the units.

Figure 2. Main tectonic units of the Caucasus (modified after Gamkrelidze, 1997).



US - Uljanovsk-Saratov Trough
RS - Ryazan-Saratov Trough
VU - Volga-Ural Arch
B - Belarussian Arch
MD - Moscow Basin
PT - Pripyat Trough
DDB - Dniepr-Donets Basin
D - Donbass Basin
KS - Karpinski Swell
RD - Rostov Dome

Figure 3. Main tectonic units of the Russian Platform (modified after Nikishin et al., 1996).



sections:
1 - Khadzhokh-1
2 - Khadzhokh-2
3 - Belaja
4 - Rufabgo
5 - Gud
6 - Sakhraj
7 - Bezymajnnaja
8 - Gruzinka
9 - Sjug
10 - Lipovyj
11 - Khamyshki-1
12 - Khamyshki-2
13 - Kisha
14 - Petschera Nezhnaja
15 - Dakhovskaja
16 - Moltchepa

Figure 4. Location of sections in the Laba-Malka area.

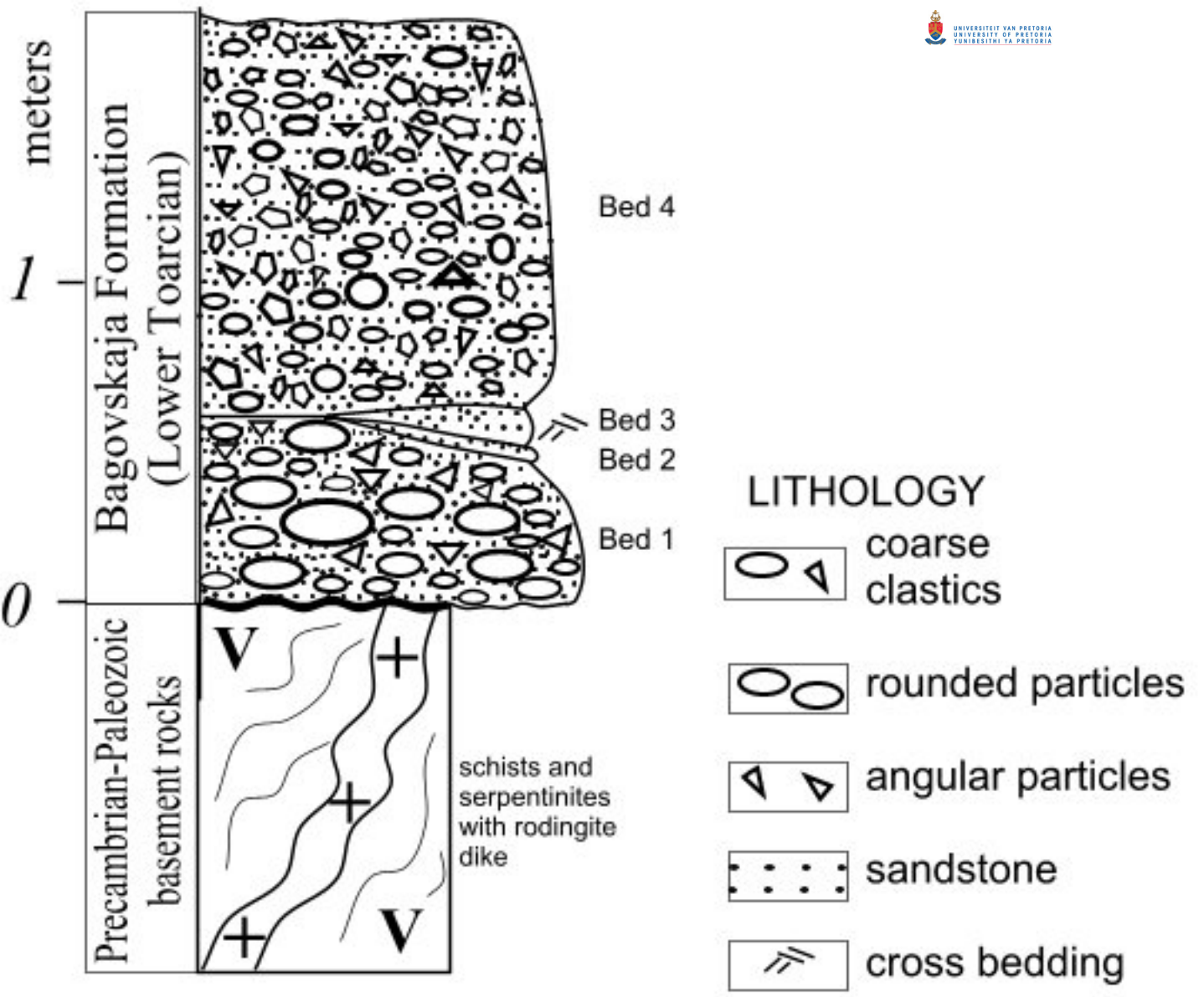


Figure 5. The Lipovyj section (see Fig. 4 for location).

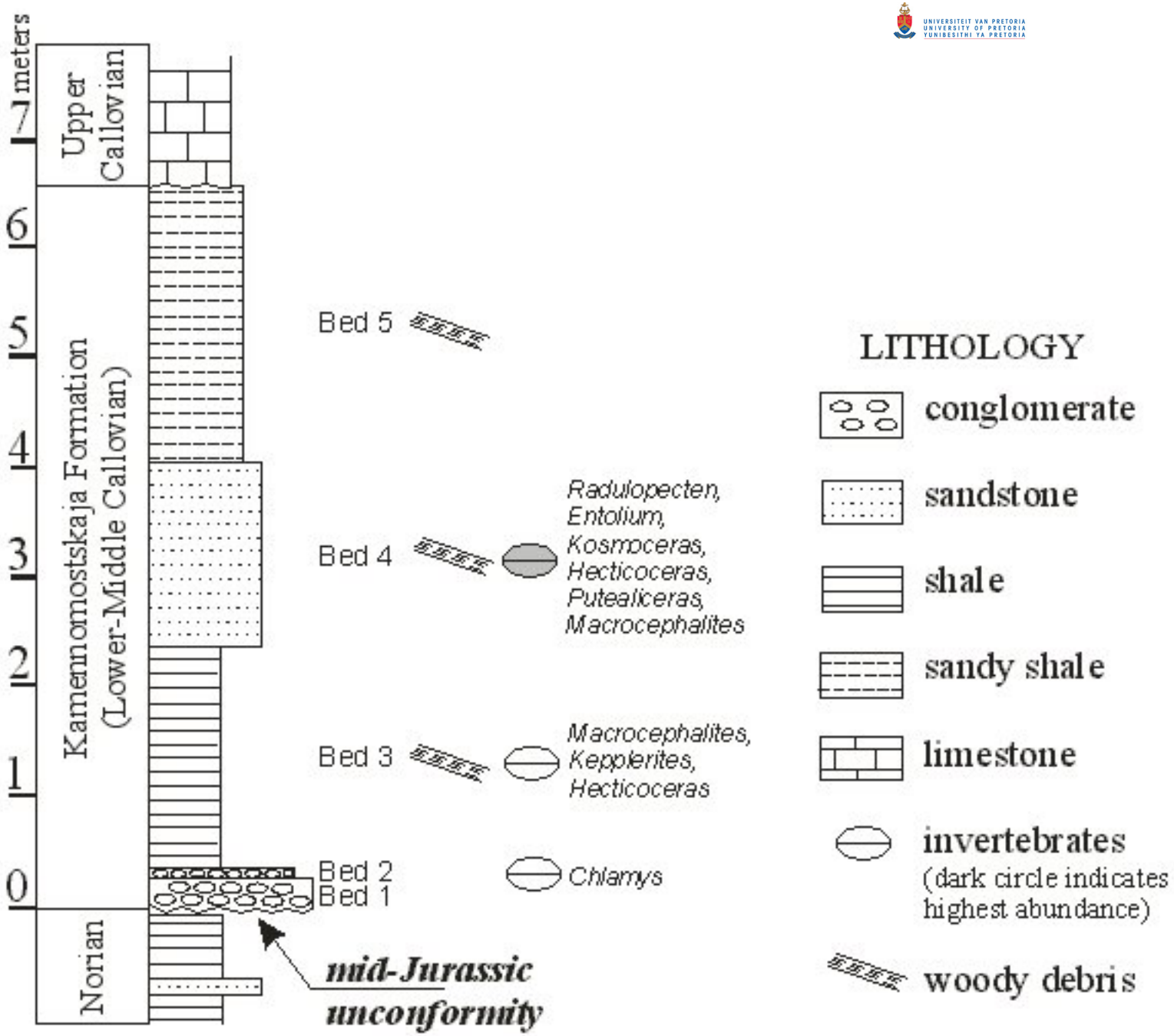


Figure 6. The Khadzhokh-2 section (see Fig. 4 for location) (modified from Ruban, 2007b).

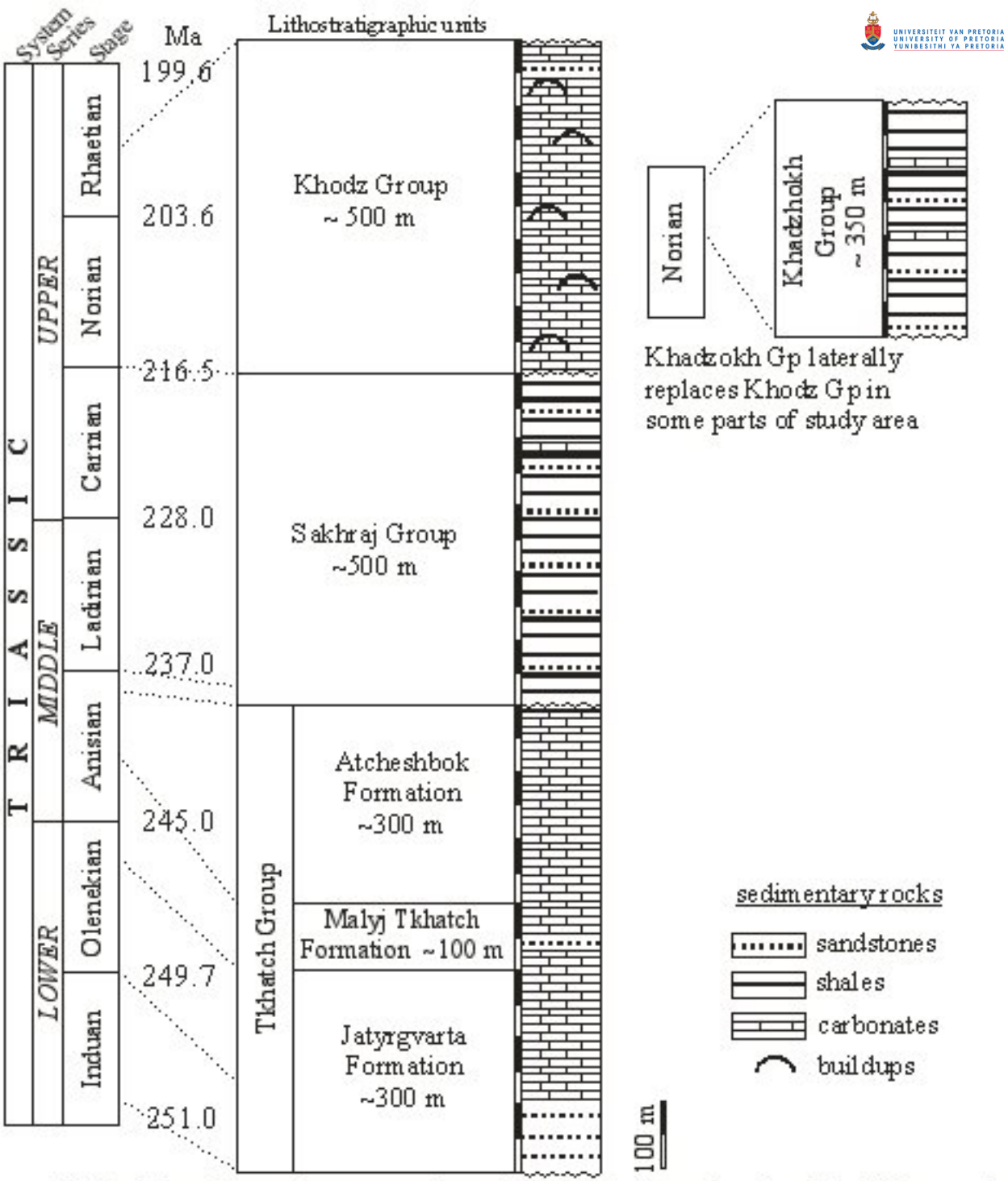


Figure 7. Stratigraphy and a composite section of the Triassic deposits of the western part of the Greater Caucasus (after Ruban, 2008; based on data from a number of sections and outcrops).

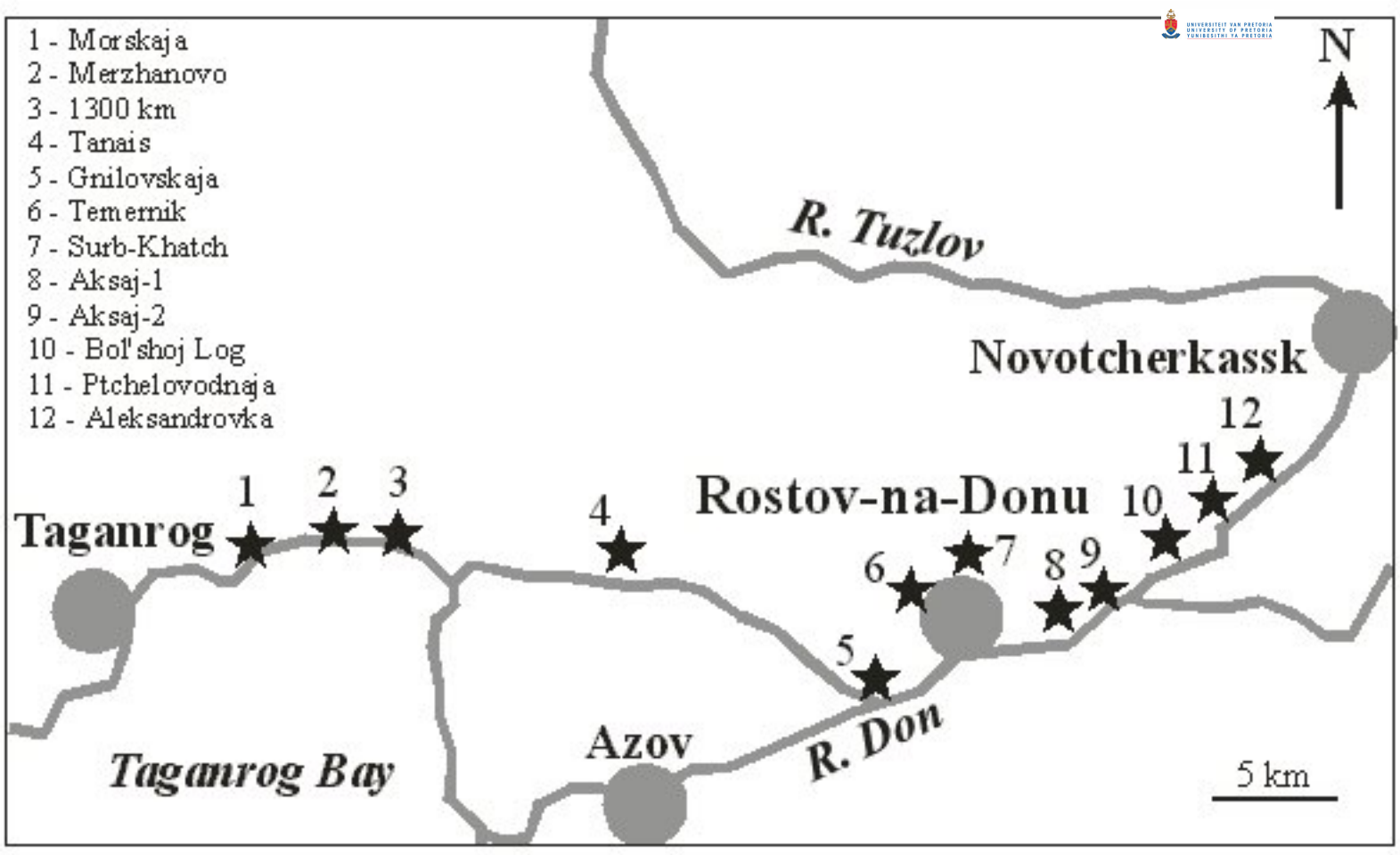


Figure 8. location of the studied Upper Miocene sections in the Rostov Dome.

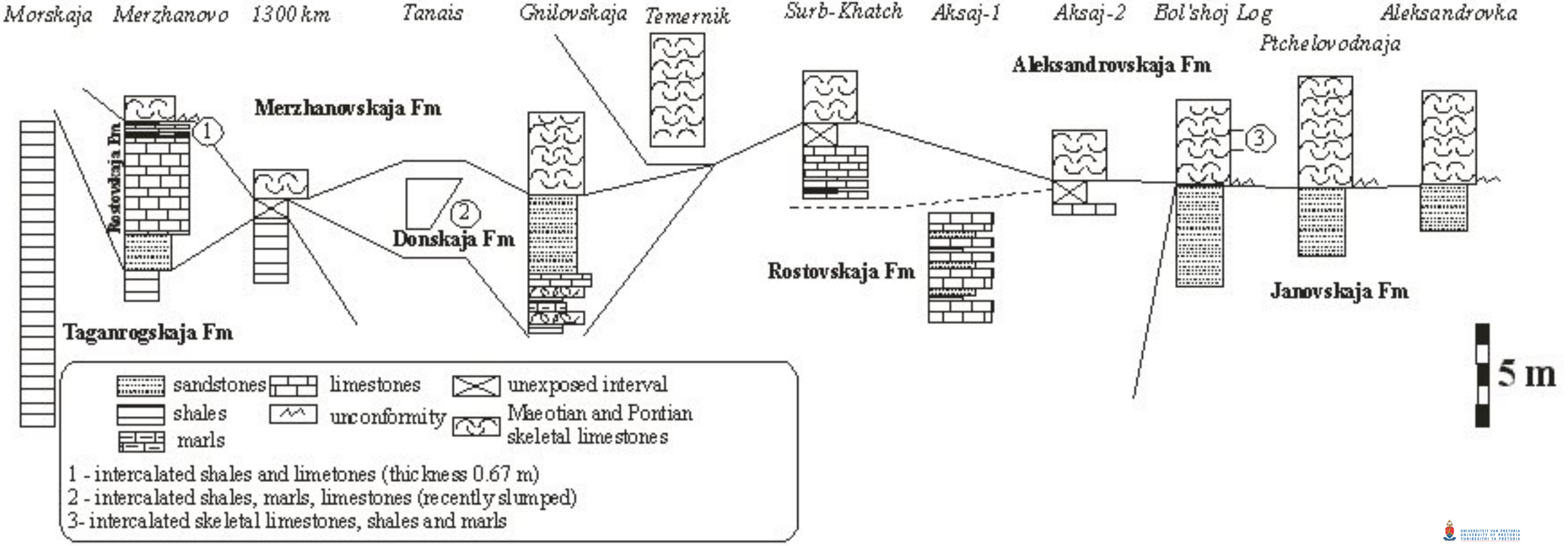


Figure 9. Correlation of the Upper Miocene sections of the Rostov Dome (after Ruban, 2005a). See Ruban (2005a) for precise formation ages.

Appendix 1. List of identified Jurassic bivalves from the Laba-Malka area (see Fig. 4 for section location).

BEZYMJANNAJA SECTION
Plagiostoma cf. *subrigidula* (Schlippe, 1888), *Plagiostoma* sp.
samples: BG-1, BG-2
lithostratigraphy: Bizhgon Member (crinoidal limestones)
age*: late Aalenian*
source: Ruban, D.A., Valentseva, D.R., Skljarov, V.V. & Khokhlatcheva, N.V. 2007. New data on the Aalenian-Bejocian stratigraphy in the River Belaja watershed (Northwestern Caucasus). In: Alekseev, A.S. (Ed.). Paleostrat-2007. MOIP, Moskva. pp. 22-23. (in Russian)

KHADZHOKH-2 SECTION
Chlamys (Chlamys) viminea (Sowerby, 1826), *Ctenostreon* sp., *Entolium demissum* (Phillips, 1829), *Entolium* sp., *?Entolium* sp., *?Pleuromya* sp., *?Pseudolimea* sp., *?Pseudolimea* cf. *Limea* sp., *Radulopecten (Radulopecten) subinaequicostatus* (Kasansky, 1909), *?Radulopecten (Radulopecten)* sp., *?Sublatachlamys* aff. *suchubika* Romanov, 1985.
samples: cl-03-X-01, cl-03-X-02, cl-03-X-03, cl-03-X-04, cl-03-X-05, cl-03-X-06, cl-03-X-07, cl-03-X-08, cl-03-X-09, cl-03-X-10, cl-03-X-11, cl-03-X-12, cl-03-X-14, cl-03-X-16, cl-03-X-20, cl-03-X-22, cl-03-X-24, cl-03-X-25
lithostratigraphy: Kamennomostskaja Formation (basal conglomerates and sandstones - beds 2 and 4)
age*: early-middle Callovian*
source: Ruban, D.A. 2005. New data on the Callovian fauna of the Northwestern Caucasus. Nautchnaja mysl' Kavkaza, Prilozhenie. 13: 138-140. (in Russian)

DAKHOVSKAJA SECTION
Entolium demissum (Phillips, 1829), *?Entolium* sp., *?Mytiloceramus* sp.
samples: cl-03-4500-01, cl-03-4500-03, cl-03-4500-04, cl-03-4500-05, cl-03-4500-06, cl-03-4500-07, cl-03-4500-08
lithostratigraphy: Gerpegemskaja Formation (lower part of carbonate succession)
age*: late Callovian*
source: Ruban, D.A. 2005. New data on the Callovian fauna of the Northwestern Caucasus. Nautchnaja mysl' Kavkaza, Prilozhenie. 13: 138-140. (in Russian)

Appendix 2. Compiled list of genera of the Triassic marine biota of the Western Caucasus (after Ruban, 2006b). Number of species in each genus in the Triassic stages is indicated.

Genera	Induan+Olenekian	Anisian	Ladinian	Carnian	Norian	Rhaetian
AMMONOIDS						
Acrochordiceras		3				
Aegeiceras		1				
Arcestes			1			3
Arpadites		1				
Badiotites			1			
Beyrichites		1				
Caucasites		2				
Cladiscites					2	2
Dieneroceras	1					
Flemingites	1					
Flexoptychites		1		1		
Gymnites		1				
Hollandites		3				
Japonites		1				
Joannites				1		
Juvavites					1	
Laboceras		3				
Leyophyllites		4				
Lobites					1	
Longobardites		1				
Megaphyllites		1			2	1
Mesocladiscites		1				
Monophyllites		1	3			
Nannites	1					
Owenites	3					
Paracladiscites						2
Paradanubites		2				
Paragoceras	1					
Parasageceras		1				
Parussuria	1					
Phyllocladiscites		2				
Pinacoceras					1	1
Placites					1	1
Proptychites	1					
Pseudosageceras	1					
Rhacophyllites					1	1
Smithoceras		1				
Sturia		2	1			

Subowenites	1					
Subvishnuites	1					
Wyomingites	1					
Xenodiscus			1			
ALGAE						
Lithotamnidium					1	
Spongiomorpha					4	
BRACHIOPODS						
"Rhynchonella"		1				
Abrekia	1					
Adygella				1	1	1
Adygelloides						1
Amphiclina					1	2
Ampliclinodonta					1	
Angustothyris		1				
Aulacothyropsis				1		4
Austriella					1	
Austrirhynchia						2
Balatonospira				1		
Bobukella				1	1	
Caucasorhynchia					1	1
Caucasothyris					1	
Coenothyris		2				
Costirhynchia		1		1		
Costispiriferina		1				
Crurirhynchia					1	
Crurithyris	1					
Cubanothyris					2	2
Decurtella		2				
Dinarispira		2				
Dioristella		1		1		
Euxinella					3	6
Fissirhynchia					1	1
Guseriplia						2
Holcorhynchella		1				
Koeveskallina		1				
Koninckina				1	1	
Laballa					2	3
Lepismatina						1
Lobothyris					2	
Majkopella						3
Mentzelia		1		2	1	2
Moisseievia					2	1
Neoretzia						3
Neowelerella	1					
Norella		1				
Oxycolpella					3	2
Pexidella		1			1	
Piarorhynchella		1				
Pseudocyrtina					1	

Pseudorugitella					2	2
Punctospirella		1				
Rhaetina				1	6	4
Rhimirhynchopsis					1	1
Robinsonella						1
Sinucosta		1			1	1
Spinolepismatina					1	
Sulcatinella		2				
Sulcatothyris				1		
Tetractinella		1				
Thecospira					1	
Thecospiropsis					1	
Triadithyris					2	1
Trigonirhynchella					1	2
Volirhynchia		2				
Wittenburgella					1	1
Worobievella					1	1
Zeilleria					3	6
Zugmayerella						1
BIVALVES						
Cassianella					1	
Claraia	4					
Daonella			2			
Halobia			1	5		
Hoernesia		1				
Indopecten					1	
Leda			1			
Limea		1				
Lyssochlamys				2		
Monotis					3	
Myophoria					1	
Mytilus		1				
Paleocardita					1	
Posidonia		1	1			
Pseudomonotis					1	
Schafhaeutlia		1				
Velopecten		1		1		
CORALS						
Astraeomorpha					2	1
Montlivaultia					1	
Rhabdophyllia					1	
Stephanocoenia					1	
Stylophyllopsis					2	
Thamnastraea					2	2
Thecosmilia					6	2
FORAMINIFERS						
"Frondicularia"						2
"Orthovertella"	1					
"Protonodosaria"	1					
"Tetrataxis"					1	1

Agathaminina					1	1
Ammobaculites		2		1	1	
Ammodiscus	1		2	1	1	
Angulodiscus					1	1
Arenovidalina		4				
Astacolus		2	1	3		
Auloconus					1	1
Aulotortus					3	3
Calcitornella		1	1			
Cornuloculina		1		1	1	1
Cornuspira				1		
Coronipora						1
Dentalina	3	5	6	4		
Diplotremmina		1		1		
Duostomina		1	1			
Duotaxis						1
Earlandia		1				
Galeanella					1	2
Gandinella	1					
Gaudryina				2		1
Gaudryinella						1
Glomospira		2				
Glomospirella		3				1
Hoyenella	1	1				2
Hyperammina		2		1		
Ichtyolaria				2		
Involutina					2	2
Labalina				1		
Lagena		1				
Lenticulina			4	3		2
Lingulina		2	4	1		
Marginulinopsis				1		
Meandrospira	2	3				
Miliolipora					1	1
Nodosaria	5	2		6		2
Nodosinella		1				
Ophthalmidium			1	2	3	4
Pachyphloides			1	2		
Pilammina		3				
Planiinvoluta					1	4
Pseudonodosaria		7	9	5		
Quinqueloculina			1			
Reophax			2			
Saccammina		1				
Semiinvoluta					1	1
Spiroplectammina		1		1		
Tetrataxis					1	
Tolypammina		3				
Triasina					1	
Trochammina		1		2	2	3

Trocholina		1	3	4
Turrispirillina				1
Vaginulina	1			
Vaginulinopsis	1			
SPONGES				
Hodsia			1	
Molengraffia			1	
Sahraja			1	

Appendix 3. Stratigraphic distribution of brachiopods in the Northern Caucasus (after Ruban, 2006a with modifications and additions). Number of species of each genera in the Triassic-Lower Cretaceous stages is indicated.

CAMBRIAN

Acrotreta gerassimovi Lermontova - Middle Cambrian

DEVONIAN

Cingulodermus ex gr. *superstes* (Barrande), *Clorinda pseudolinguifera* (Kozlowski) and *Janius* ex gr. *irbitensis* (Tschernyshova) - Lochkovian

Ivdelina (Procerulina) ex gr. *procerula* (Barrande) - Pragian

Atrypa posturalica Markowskii, *Gypidula comis* Owen, *Hypothyridina cuboides* Sowerby, *Spinatrypa* ex gr. *bifidaeformis* Tschernyshova - Frasnian

Cyrtospirifer verneuili (Murchison), *Cyrtospirifer* cf. *calcaratus* Sowerby, *Cyrtospirifer* cf. *archiaci* Murchison, *Cyrtospirifer* cf. *postarchiaci* Nalivkin, *Isopoma brachyptycta* (Schnur), *Productus* sp., *Productella* ex gr. *subaculeata* (Murchison), *Productella calva* var. *multispinosa* Sokolskaya, *Productella calva* var. *koscharica* Nalivkin, *Pugnax janischevskii* Rozman, *Rhipidiorhynchus* ex gr. *livonicus* Buch - Famennian

CARBONIFEROUS

Spirifer cf. *distans* Sowerby - Mississippian

PERMIAN

Anidanthus, Cathaysia, Caucasoproductus, Chonetella, Compressoproductus, Crurithyris, Denticuliphoria, Derbyia, Dielasma, Edriosteges, Enteletella, Enteletes, Gefonia, Gerassimovia, Haydenella, Hemiptychina, Heterelasmina, Hybostenoscisma, Krotovia, Labaella, Labaia, Lamnimargus, Leptodus, Licharewiconcha, Licharewina, Linoproductus, Marginifera, Martinia, Nikitinia, Notothyris, Permianella, Permophricodothyris, Phricodothyris, Prelissorhynchia, Probolionia, Prorichthofenia, Pseudowellerella, Rhipidomella, Richthofenia, Rostranteris, Scacchinella, Semibrachithyrina, Spinomarginifera, Stenoscisma, Stenoscismatoidea, Strophalosia, Strophalosiina, Tectarea, Terebratuloidea, Tethysiella, Transennatia, Tyloplecta, Uncinunellina, Urushtenia, Wellerella - Changhsingian

TRIASSIC

GENERA	I+O	An	La	Ca	No	Rh
"Rhynchonella"		1				
Abrekia	1					
Adygella				1	1	1
Adygelloides						1
Amphiclina					1	2
Ampliclinodonta					1	
Angustothyris		1				
Aulacothyropsis				1		4
Austriella					1	
Austrirhynchia						2
Balatonospira				1		
Bobukella				1	1	
Caucasorhynchia					1	1
Caucasothyris					1	
Coenothyris		2				
Costirhynchia		1		1		

Costispiriferina				1					
Crurirhynchia								1	
Crurithyris			1						
Cubanothyris								2	2
Decurtella				2					
Dinarispira				2					
Dioristella				1			1		
Euxinella								3	6
Fissirhynchia								1	1
Guseriplia									2
Holcorhynchella				1					
Koeveskallina				1					
Koninckina							1	1	
Laballa								2	3
Lepismatina									1
Lobothyris								2	
Majkopella									3
Mentzelia				1			2	1	2
Moisseievia								3	
Neoretzia									3
Neowelerella			1						
Norella				1					
Oxycolpella								3	2
Pexidella				1				1	
Piarorhynchella				1					
Pseudocyrtina								1	
Pseudorugitella								2	2
Punctospirella				1					
Rhaetina							1	6	4
Rhimirhynchopsis								1	1
Robinsonella									1
Sinucosta				1				1	1
Spinolepismatina								1	
Sulcatinella				2					
Sulcatothyris							1		
Tetractinella				1					
Thecospira								1	
Thecospiropsis								1	
Triadithyris								2	1
Trigonirhynchella								1	2
Volirhynchia				2					
Wittenburgella								1	1
Worobievella								1	1
Zeilleria								3	6
Zugmayerella									1

stage abbreviations: In – Induan, Ol – Olenekian, An – Anisian, La – Ladinian, Ca – Carnian, No – Norian, Rh – Rhaetian.

JURASSIC

GENERA	Si	Pl	To	Aa	Bj	Bt	Cl	Ox	Km	Tt
"Rhynchonella"	2	1	2	2	2					
"Spiriferina"	1	1								

"Terebratula"						1	1		2
Acanthorhynchia							1		
Acanthothyris				1	3				
Aromasithyris						1	2	1	
Aulacothyris		2	1			2			
Bodrakella		1							
Calcirhynchia	1	1							
Calvirhynchia					1				
Capillirhynchia				1		1			
Cardinirhynchia						1			
Caucasella						1			
Caucasorhynchia		1							
Cererithyris					1				
Cheirothyris									1
Cincta		2							
Cirpa		1							
Colosia							2	1	
Cryptorhynchia					1				
Cuersithyris		1							
Cuneirhynchia		4							
Curtirhynchia			1						
Digonella		1					1		
Disculina		1							
Dorsoplicathyris						2			
Ferrythyris						1			
Flabellirhynchia		1	1						
Furcirhynchia	1			1	1				
Gibbirhynchia	1	2	1						
Goniothyris						1		1	1
Grandirhynchia			1	1	1				
Gusarella						1			
Heimia					1				
Homoeorhynchia	1	2	1						
Ismenia									2
Ivanoviella						3	1		
Juralina							5	1	2
Lacunosella						1	3	2	1
Linguithyris	1				1				
Liospiriferina	2	4	1						
Loboidothyris					1		1		
Lobothyris		3	1	2	2				
Lophothyris								1	
Monsardithyris					1				
Monticlarella								1	2
Morrisithyris					1	1			
Nucleata							2	1	1
Paruirhynchia				1					
Piarorhynchia	1	4	1						
Postepithyris								1	
Praemonticlarella			1						
Prionorhynchia	1	1	1						
Pseudogibbirhynchia			2	2	2				

Ptyctorhynchia			1							
Ptyctothyris					1		3			
Quadratirhynchia					2					
Rhactorhynchia					3					
Rhynchonelloidea				1						
Rhynchonelloidella							1			
Rimirhynchia		1								
Rudirhynchia	2									
Rugitela					1					
Scalpellirhynchia	1									
Securina	1	1								
Sellithyris								1	1	
Septaliphoria							2	2		6
Somalirhynchia								1		
Sphaeroidothyris					2					
Spiriferina	4	3								
Squamirhynchia		1								
Stolmorhynchia				4	2		1			
Striirhynchia					1					
Stroudithyris				1						
Tchegemithyris							2			
Terebratula								1		
Tetrarhynchia	1				1					
Thurmanella							1			
Torquirhynchia								1	2	1
Trichorhynchia				2	1					
Tropeothyris										9
Tubithyris					2					
Wattonithyris					1					
Weberithyris										3
Zeilleria	15	14		3	4		2	1		

stage abbreviations: Si – Sinemurian, Pl – Pliensbachian, To – Toarcian, Aa – Aalenian, Bj – Bajocian, Bt – Bathonian, Cl – Callovian, Ox – Oxfordian, Km – Kimmeridgian, Tt – Tithonian.

LOWER CRETACEOUS

GENERA	Be	Va	Ha	Ba	Ap	Al
Belbekella	1		1	4	1	
Belothyris			1	2	2	
Orbirhynchia				1	1	
Peregrinella			1			
Praelongithyris					1	
Psilothyris		2				
Sellithyris		1	3			
Sulcirhynchia	1					
Symphythyris			1			
Terebrataliopsis		1				
Weberithyris		1				

stage abbreviations: Be – Berriasian, Va – Valangianian, Ha – Hauterivian, Ba – Barremian, Ap – Aptian, Al – Albian.