

## The History of study of Dinaric glaciation

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Gjuro Pilar, professor of geology at the University of Zagreb, wrote first account on glaciation of Dinaric mountains ever in 1877, 37 years after Agassiz' Neuchatel lecture. However, the idea of glaciated Dinaric mountains was not readily accepted, but was strongly criticized by Dragutin Gorjanović (1902, 1907) who wrote that he wanted "to settle the debate once and for all." Gjuro Pilar died in 1893, and did not witness fierce battle between Gorjanović and Hinko Hranilović over the evidence of glaciation of the Dinaric mountains, Velebit and Medvednica in particular in the year of 1906. Not only Gorjanović opposed any idea of Dinaric glaciation, but also his successor Josip Poljak (1947) who made strong effort to silence all proponents of the glaciation in these regions. So, it was not before 1973, when Nikler wrote his paper on a moraine ridge Rujanska kosa on the southern Velebit Mt., and thereafter the Dinaric glaciation became accepted at least locally, but nearly 100 years after Pilar's paper. Although it may seem that after this discovery, the study of glacial traces in Dinarides would be accelerated, it actually did not imply significant progress until 1980-es and 1990-es, at least in respect to the number of published papers. Indeed, a lot of field research was performed, and the first Master's Thesis on glacial history of the Velebit Mt. was defended at the University of Beograd by Srđan Belij in 1984. The progress in research was nevertheless very slow, partly because the lack of specific knowledge and experience in paleoglaciological study, partly because of general scepticism about glaciation in central Europe, so the next defended Doctoral Thesis was by Ljerka Marjanac in 2012, almost 30 years later. Herein we present a historical overview of all published papers, thesis, abstracts and field guides related to glaciation of the Croatian Dinarides. The list is not fully completed, because some old publications are hard to obtain, but it provides a source of information on the available publications.

### Chronological list of publications related to research and debate on glaciation of the Dinarides (publication main topics: GEO = geology, GM = geomorphology)

YEAR	REFERENCE	GEO	GM
1877.	Pilar Gj. (1877): Tragovi oledbe na podnožju zagrebačke gore. Rad Jugosl. Akad. Znan. Umj. 39, 142-150.	✓	
1900.	Penck, A. (1900): Die Eiszeit auf der Balkanhalbinsel. Globus 78, 133-178.		✓
1901.	Hranilović H. (1901): Geomorfološki problemi iz Hrvatskog Krasa. Glasnik Hrv. Naravosl. društva 13/1-3, 93-133.		✓
1902.	Gorjanović D. (1902): Geomorfološki problemi iz hrvatskog krasa. Glasnik Hrv. naravosl. društva 13/4-6, 193-196.		✓
1902.	Hranilović H. (1902): Odgovor g. prof. dr. D. Gorjanoviću na kritiku "Geomorfološki problemi iz hrvatskog Krasa". Glasnik Hrv. naravosl. društva 13/4-6, 196-203.		✓
1902.	Gorjanović D. (1902): Odgovor Hraniloviću. Glasnik Hrv. naravosl. društva 13/4-6, 203-205.		
1903.	Gavazzi A. (1903): Tragovi oledbe u našem kršu. Glasnik Hrv. naravoslovnog društva 14, 174-175.		✓
1903.	Gavazzi A. (1903): Trag oledbe na Velebitu? Glasnik Hrv. naravoslovnog društva 14., 459.		✓
1904.	Hranilović H. (1904): Topusko (crtice iz poluzaboravljenog kraja). Hrvatski planinar 7-8, 49-57.		✓

1906.	Gorjanović, D. (1906): Da li je bila gora zagrebačka oledjena i kako je postala zagrebačka terasa? Narodne novine 72/121, 3-4.	✓	
1906.	Gorjanović, D. (1906): Da li je bila gora zagrebačka oledjena i kako je postala zagrebačka terasa? Narodne novine 72/122, 3-4.	✓	
1906.	Hranilović H. (1906): Odgovor g. prof. Gorjanović-Krambergeru na njegovo predavanje: Da li je bila zagrebačka gora oledjena i kako je postala zagrebačka terasa? Narodne novine 72/147, 3-4.	✓	
1906.	Gorjanović, D. (1906): Protuodgovor g. prof. Hraniloviću na njegove primjedbe o mom predavanju o tobožnjoj oledbi Zagrebačke gore. Narodne novine 72/148, 3.	✓	
1906.	Hranilović H. (1906): Gosp. prof. Gorjanoviću na njegov "Protuodgovor". Narodne novine 72/152, 4-5.	✓	
1907.	Gorjanović, D. (1907): Da li je bila gora Zagrebačka oledjena i kako je postala zagrebačka terasa. Glasnik Hrv. Naravoslovnog društva 19, 37-43.		✓
1908.	Gorjanović, D. (1908): War das Zagraber Gebirge vergletschert und wie ist die Zagraber Terasse entstanden? Bull. Soc. hongroise geogr., 36/3, Budapest, 33-46.	✓	
1909.	Schubert R. (1909): Geologija Dalmacije. Matica Dalmatinska, Zadar, 3-183.	✓	
1915.	Gregory J.W. (1915): Pseudo-Glacial Features in Dalmatia. The Geographical Journal 46/2, 105-117.		✓
1917.	Cvijić J. (1917): L'Epoque glaciaire dans le Péninsule balkanique. Ann. Géographique 26/141, 189-218.		✓
1922.	Milojević B.Ž. (1922): Beleške o glečerskim tragovima na Raduši, Cinceru, Šatoru, Troglavu i Velebitu. Glasnik geografskog društva 7-8, 294-297.	✓	
1931.	Roglić J. (1931): Glacijalni tragovi na Biokovu. Posebno izdanje srp. geogr. društva 10, Beograd, 49-51.		✓
1934.	Bauer B. (1934/35): Über die Landformen des Nördlichen Velebit. Jb. bundes -Real Gymnasiums, Knittelfeld, 49 p.		✓
1935.	Roglić J. (1935): Biokovo - geomorfološka ispitivanja (La montagne de Biokovo. Etude geomorphologique). Posebno izdanje srp. geogr. društva 18, Beograd, 1-96.		✓
1936.	Degen A. (1936): Flora Velebitica, 1. 7-202, Verleuterung Ungarische Akademie der Wissenschaften, Budapest.		✓
1947.	Poljak J. (1947): O zaledjenju Velebita. Geol. vjesnik 1, 125-148, Zagreb.	✓	
1959.	Šifrer M. (1959): Obseg pleistocenske poledenitve na Notranjskem Snežniku. Geografski zbornik SAZU 5, 27-80, Ljubljana.		✓
1960.	Šegota T. (1960): Geografske osnove glacijacije. Prilog teoriji uzroka i posljedica glacijacije. Doctoral Thesis, University of Zagreb. 1-184.		
1963.	Roglić J. (1963): Glaciation of the Dinaric mountains and its effects on the Karst. Report of the 6 <sup>th</sup> Int. Congr. on Quaternary, Warsaw 1961, I, Geomorphological sect., 293-299, Łódź.		✓
1968.	Malez M. (1968): O razvoju kvartara na području vanjskih Dinarida. I kol. geol. Dinarida, Ljubljana 1966, I, 203-210.	✓	
1973.	Nikler L. (1973): Nov prilog poznavanju oledbe Velebita. Geol. vjesnik 25 (1971), 109-112.	✓	
1984.	Belij S. (1984): Glacijalni i periglacijalni reljef južnog Velebita. Magister's Thesis, University of Beograd.		✓
1985.	Belij S. (1985): Glacijalni i periglacijalni reljef južnog Velebita. Posebno izdanje Srp. geogr. društva 61, 5-68.		✓
1985.	Belij S. (1985): Glacijalni reljef južnog Velebita. Geografski glasnik 47, 71-85.		✓
1987.	Klein V. (1987): Utjecaj prstenastih morfostrukture na oblikovanje glacijalnog reljefa južnog Velebita. Zbornik II znanstv. skupa geomorfologa SFRJ, Gospić-Južni Velebit, 133-143.		✓
1987.	Klein V., Belij S. & Blazek I. (1987): Utjecaj dinamičkih tektomorfoloških činilaca na glacijaciju Dinarida. Zbornik II znanstv. skupa geomorfologa SFRJ, Gospić-južni Velebit, 55-67.		✓
1988.	Belij S. (1988): Glacijalni reljef južnog velebita. Priroda 76/5-6, 158-164.		✓

1990.	Marjanac T., Marjanac Lj. & Oreški E. (1990): Glacijalni i periglacijalni sedimenti u Novigradskom moru. Geol. vjesnik 43, 35-42.	✓	
1991.	Bognar A., Faivre S. & Pavelić J. (1991): Tragovi oledbe na Sjevernom Velebitu. Geografski glasnik 53, 27-39.		✓
1991.	Marjanac T. & Marjanac Lj. (1991): Pleistocene glacial and periglacial deposits on Middle Adriatic coast. 12 <sup>th</sup> IAS Reg. Meeting, Bergen 1991, Abstracts, 32.	✓	
1992.	Marjanac T. & Marjanac Lj. (1992): Pleistocene glaciation of Northern Adriatic region. Int. Symp. Geomorph. and the Sea and Meeting Geomorph. Comm. Carpato-Balkan countries IGU, Mali Lošinj 1992, Abstracts, 14.	✓	
1994.	Marjanac L. & Marjanac T. (1994): Slopeward-dipping terraces on NE Adriatic islands, Pleistocene low altitude kame-terraces? 15 <sup>th</sup> Reg. Meeting IAS, Ischia 1994, Abstracts, 271-272.	✓	
1995.	Bognar A., Pavličević D. & Pavelić J. (1995): Glaciofluvijalne plavine u izvorišnom dijelu bazena porječja vodotoka Velike Paklenice. Paklenički zbornik 1, 43-47.	✓	✓
1997.	Bognar A. & Prugovečki I. (1997): Glaciation Traces in the Area of the Risnjak Mountain Massif. Geologia Croatica 50/2, 269-278.		✓
1997.	Bognar A., Faivre S. & Pavelić J. (1997): Tragovi oledbe na Srednjem Velebitu, Senjski zbornik, 24, Senj 1997, 1-16.		✓
1997.	Marjanac, Lj. & Paunović, M. (1997): Glacial and periglacial paleoenvironments as evidence of ice age maximum in Croatia. Europol. 1, 11/12; 26-27.	✓	
1999.	Marjanac Lj. & Marjanac T. (1999): Quaternary clastics of Jablanac cove in the foothills of the Velebit Mt. U: Harold Reading's IAS Lecture Tour '99 - Field-trip guidebook: Some Carbonate and Clastic Successions of the External Dinarides, 26-28.	✓	
1999.	Marjanac Lj. & Marjanac T. (1999): Glacijalni sedimenti sjeverne Dalmacije. Geotrip '99: Velebit, Novigradsko more, Paklenica., 21-35.	✓	
1999.	Marjanac Lj. & Marjanac T. (1999): Polyphase kame terraces on the Island of Pag (Eastern Adriatic, Croatia). Field Symposium on Pleistocene Stratigraphy and Glacial Chronology, Southern Estonia 1999, Tartu 1999, Abstracts, 34-35.	✓	
2000.	Marjanac L. & Marjanac T. (2000): Pleistocene sediments at Novigrad Sea - evidence of glaciation of coastal Adriatic (northern Dalmatia, Croatia). INQUA-SEQS Quaternary Stratigraphy and Evolution of the Alpine Region in the European and Global Framework, Milano 11.-15.9.2006, Volume of Abstracts (ed. Pini R. & Ravazzi C.), 119-120.	✓	
2000.	Marjanac T. & Marjanac Lj. (2000): Glacioistostatic rebound of External Dinarides. Pancardi 2000, Abstracts, Vijesti HGD 37/3, 77-78.	✓	
2001.	Marjanac Lj., Marjanac T. & Mogut K. (2001): Dolina Gumance u doba pleistocena. Zbornik društva za povjesnicu Klana 6, 321-330, Klana.	✓	
2001.	Surić, M., Juračić, M. & Horvatinčić, N. (2001): Determination of Late Pleistocene and Holocene sea level changes in the Adriatic - A review and new attempts . I International Congress "Seas and Oceans", Szczecin 2000, Proceedings, 529-534.	✓	
2002.	Marjanac, T. & Marjanac, Lj. (2002): Pleistocene deltical sequence of Seline near Mala Paklenica - document of climatic oscillations. Carpatho-Balkan workshop on Environmental change impacts in the Carpatho - Balcan Region, Zagreb 2002, Absrtacts, 15.	✓	
2002.	Perica, D., Lozić, S. & Mrak, I. (2002): Periglacijalni reljef na području Velebita. Geoadria 7/1, 5-29.		✓
2002.	Surić, M., Juračić, M. & Horvatinčić, N. (2002): Late Pleistocene - Holocene changes of the eastern Adriatic coast line. In. The Changing Coast (ed. by Veloso-Gomes, F. , Taveira-Pinto, F. & das Neves, L.), Proceedings of the 6 <sup>th</sup> int. symposium Eurocoast/EUCC, Littoral 2002, Porto 2002, vol. III, 259-263.	✓	
2004.	Marjanac Lj. & Marjanac T. (2004): Quaternary glacial and associated deposits of Velika Paklenica and Rujno (Southern Velebit Mt., Croatia). In: Adriatic-Dinaric Mesozoic carbonate platform, environments and facies from Permian to recent time. 32th International geological congress, Florence - Italy, August 20-28, 2004, Field-trip guidebook - P53, 27-29.	✓	

2004.	Marjanac Lj. & Marjanac T. (2004): Glacial history of Croatian Adriatic and Coastal Dinarides. In: Quaternary Glaciations - Extent and Chronology (ed. by J. Ehlers & P.L. Gibbard). Developments in Quaternary Science, 2a, Elsevier. 19-26.	✓	
2006.	Bognar A. & Favre S. (2006): Geomorphological Traces of the Younger Pleistocene Glaciation in the Central Part of the Velebit Mt. Hrv. geografski glasnik 68/2, 19-30, Zagreb.		✓
2006.	Marjanac Lj. & Marjanac T. (2006): 7. Glaciation of the External Dinarides. Adria 2006, International Geological Congress on the Adriatic area, Urbino 2006, Field trip Guide, 32-33.	✓	
2006.	Marjanac Lj. & Marjanac T. (2006): Obrovac moraine - new evidence of extent of glaciation in Dinarides. Adria 2006, International Geological Congress on the Adriatic area, Urbino 2006, Abstracts, 75.	✓	
2006.	Marjanac T. & Marjanac Lj. (2006): Stop 1.3. Topics: Glacial and proglacial deposits of Novigradsko More. Adria 2006, International Geological Congress on the Adriatic area, Field trip Guide, Urbino, 42-43.	✓	
2006.	Marjanac T. & Marjanac Lj. (2006): Stop 1.4. Topics: Obrovac - Pleistocene Diamictite (lateral Moraine). Adria 2006, International Geological Congress on the Adriatic area, Field trip Guide, Urbino, 44.	✓	
2006.	Marjanac T. & Marjanac Lj. (2006): Stop 1.5. Topic: The glacial and proglacial deposits of south Velebit Mt. (Velika Paklenica). Adria 2006 International Geological Congress on the Adriatic area, Field trip Guide, Urbino, 44-46.	✓	
2008.	Marjanac Lj., Marjanac T. & Hughes Ph. (2008): Dinaric glaciation - a formal proposal of a new model. INQUA-SEQS 2008 Differences and similarities in Quaternary stratigraphy between Atlantic and continental Europe, 22-27.9.2008, Rennes, Conference abstracts (ed. by Monnier J.L., Lefort J.P. & Danukalova G.), 29-30, Laboratoire d'anthropologie de Rennes.	✓	
2009.	Marjanac T. & Marjanac Lj. (2009): Ledena prošlost Dinarida. Priroda 6, 18-21.	✓	
2011.	Velić J., Velić I. & Kljajo D. (2011): Sedimentary bodies, forms and occurrences in the Tudorevo and Mirevo glacial deposits of northern Velebit (Croatia). Geologia Croatica 64/1, 1-16.	✓	
2011.	Protrka, K., Velić, J., Škrabić, H. & Velić, I. (2011): Glacijalna sedimentna tijela u Bukovačkoj dragi, SZ Biokovo. In: Scientific and professional meeting "Biokovo at the turn of the millennium - the development of Nature Park in the 21st century", Makarska 2011, 71-73.	✓	
2011.	Hughes P.D., Woodward J.C., van Calsteren P.C., Thomas L.E., Adamson K., Marjanac Lj. & Marjanac T. (2011): <i>Extent, timing and palaeoclimatic significance of Pleistocene glaciations in the Balkans: New evidence from Montenegro and correlations with Croatia</i> . 2 <sup>nd</sup> scientific meeting Quaternary geology in Croatia Zagreb 25-26.3.2011., Abstracts, 2p.	✓	
2012.	Hughes P.D. (2012): Glacial History. In: Mediterranean Mountain Environments (eds. I. N. Vogiatzakis and J. Tzanopoulos), John Wiley & Sons, Ltd, 35-63.	✓	✓
2012.	Adžić I., Marjanac T. & Marjanac Lj. (2012): Varved lacustrine sediments in South Velebit Channel, Croatia. 3 <sup>rd</sup> PAGES Varves Working Group Workshop Manderscheid (Germany) March 20-24, 2012, Program and Abstracts (ed by B. Zolitschka), Terra Nostra 2012/1, 15-20.	✓	
2012.	Marjanac Lj. (2012): Pleistocene glacial and periglacial sediments of Kvarner, northern Dalmatia and southern Velebit Mt. - evidence of Dinaric glaciation. Doctoral Thesis, University of Zagreb, XIII+277 pp.	✓	
2012.	Marjanac Lj. & Marjanac T. (2012): Distribution of Pleistocene glaciolacustrine deposits in southwestern Croatia. 3 <sup>rd</sup> PAGES Varves Working Group Workshop Manderscheid (Germany) March 20-24, 2012, Program and Abstracts (ed by B. Zolitschka), Terra Nostra 2012/1, 63-68.	✓	

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2006.	Bognar A. & Faivre S. (2006): Geomorphological Traces of the Younger Pleistocene Glaciation in the Central Part of the Velebit Mt. Hrv. geografski glasnik 68/2, 19-30, Zagreb.		✓
2006.	Marjanac Lj. & Marjanac T. (2006): 7. Glaciation of the External Dinarides. Adria 2006, International Geological Congress on the Adriatic area, Urbino 2006, Field trip Guide, 32-33.	✓	
2006.	Marjanac Lj. & Marjanac T. (2006): Obrovac moraine - new evidence of extent of glaciation in Dinarides. Adria 2006, International Geological Congress on the Adriatic area, Urbino 2006, Abstracts, 75.	✓	
2006.	Marjanac T. & Marjanac Lj. (2006): Stop 1.3. Topics: Glacial and proglacial deposits of Novigradsko More. Adria 2006, International Geological Congress on the Adriatic area, Field trip Guide, Urbino, 42-43.	✓	
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2011.	Hughes P.D., Woodward J.C., van Calsteren P.C., Thomas L.E., Adamson K., Marjanac Lj. & Marjanac T. (2011): <i>Extent, timing and palaeoclimatic significance of Pleistocene glaciations in the Balkans: New evidence from Montenegro and correlations with Croatia</i> . 2 <sup>nd</sup> scientific meeting Quaternary geology in Croatia Zagreb 25-26.3.2011., Abstracts, 2p.	✓	
2012.	Hughes P.D. (2012): Glacial History. In: Mediterranean Mountain Environments (eds. I. N. Vogiatzakis and J. Tzanopoulos), John Wiley & Sons, Ltd, 35-63.	✓	✓
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