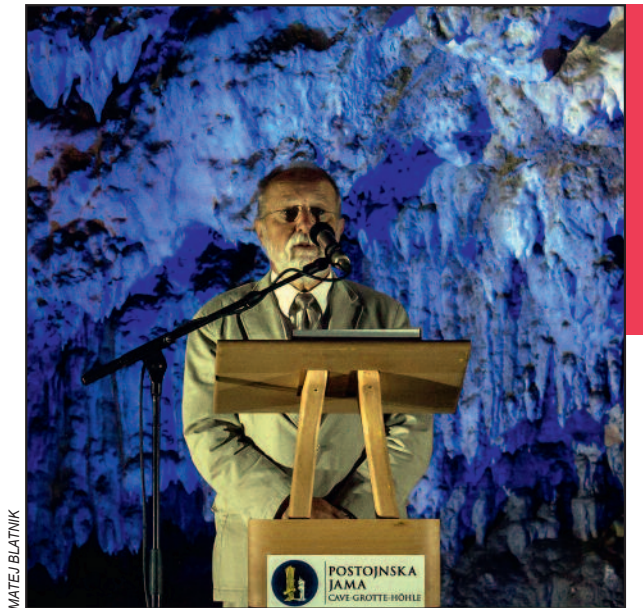


RESEARCH WORK AND CONTRIBUTION OF ANDREJ KRANJC TO GEOGRAPHY AND KARSTOLOGY

Nataša Ravbar



Andrej Kranjc during his welcoming speech at the celebration of the 50th anniversary of the International Union of Speleology in Postojna Cave on June 19th, 2015.

DOI: <https://doi.org/10.3986/AGS.12168>

UDC: 929Kranjc A.:911.2

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Research work and contribution of Andrej Kranjc to geography and karstology

ABSTRACT: Andrej Kranjc was one of the leading geographers of his generation at the national and international level. His research covers a wide range of topics related to karst geomorphology, speleology, and hydrology, as well as the history of karstology and karst terminology. This article presents his fruitful and active research activities, his contribution to geography, and his role and importance to karstology. His research and publications were honoured by his appointment as a member of the Slovenian Academy of Sciences and Arts. Through his scientific, professional, and educational work, Kranjc has had a lasting impact on Slovenian geography and has contributed significantly to the establishment of karstology in the professional community and among the general public. In addition, his work led to many important initiatives, such as the International Karstological School and the Doctoral study programme Karstology. It is also thanks to him that Slovenia is recognised as a karst country and is among the world leaders in karstology.

KEYWORDS: Andrej Kranjc, physical geography, karstology, speleology, research work

Raziskovalno delo in prispevek Andreja Kranjca h geografiji in krasoslovju

POVZETEK: Andrej Kranjc je bil eden vodilnih geografov svoje generacije na nacionalni in mednarodni ravni. Njegove raziskave zajemajo širok spekter tem, povezanih s kraško geomorfologijo, speleologijo in hidrologijo ter zgodovino krasoslovja in kraško terminologijo. V članku predstavljamo njegove plodne in aktivne raziskovalne dejavnosti, njegov prispevek h geografiji ter njegovo vlogo in pomen za krasoslovje. Za njegove raziskave in objave je bil počaščen z imenovanjem za člana Slovenske akademije znanosti in umetnosti. Kranjc je s svojim znanstvenim, strokovnim in pedagoškim delom trajno zaznamoval slovensko geografijo ter pomembno prispeval k uveljavitvi krasoslovja v strokovni in širši javnosti. Njegovo delo je pripeljalo do številnih pomembnih pobud, kot sta Mednarodna krasoslovna šola in Doktorski študijski program Krasoslovje. Tudi po njegovi zaslugi je Slovenija prepoznana kot kraška država in je med vodilnimi v svetu na področju krasoslovja.

KLJUČNE BESEDE: Andrej Kranjc, fizična geografija, krasoslovje, speleologija, raziskovalno delo

The article was submitted for publication on May 18th, 2023.

Uredništvo je prejelo prispevek 18. maja 2023.

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1 Introduction

Slovenian academic Prof. Dr. Andrej Kranjc (1943–2023) is one of the most prominent karst researchers at national and the international level, recognised for his achievements in the field of karst geomorphology and hydrology, speleology, karstological terminology and the history of karstology. Although he was a geographer specialising in physical geography, he was primarily a speleologist and karstologist who authored numerous scientific, professional, and popular articles. He was a long-time researcher at the ZRC SAZU Karst Research Institute in Postojna, a member of the Slovenian Academy of Sciences and Arts, and professor emeritus of karstology at the University of Nova Gorica.

This article is dedicated to the life, work and successful research career of Prof. Dr. Andrej Kranjc. In addition to a brief biography, his fruitful and active research activity, his contribution to geography and his role and importance in karstology, which was marked by his strong but friendly character, are highlighted.

2 Research and professional work

Andrej Kranjc was born in Ljubljana on November 5th, 1943 (Savnik 1982). He started caving at the age of 15, and the first non-tourist cave he visited was Matjaževa jama under Šmarna gora hill near Ljubljana. He joined the speleological section of the Železničar Mountaineering Club, where he got acquainted with geologist Dušan Novak, academic Prof. Dr. Jože Bole and academic Prof. Dr. Boštjan Kiauta. Initially, he was most attracted to cave biology, so much so that he wanted to study biology and specialise in the study of cave biota. However, he was also attracted to travel, so he changed his mind shortly before entering university and decided to study geography and archaeology (Ravbar 2014). While still a student, he became an employee of the Karst Research Institute ZRC SAZU in Postojna, where he worked until his retirement in 2010 (Mulec et al. 2023).



FRANCE HABE © ANDREJ KRANJC ARCHIVES

Figure 1: Andrej Kranjc in Jama v Grapi in 1971.

He graduated from the Faculty of Arts in Ljubljana in 1971, earned a master's degree in 1977 and a doctorate in 1987. The content of the bachelor's, master's and doctoral theses was a study of karst, supervised by academic Prof. Dr. Ivan Gams. In 1972, he participated in a two-month specialisation course in speleology in Moulis (France) under the supervision of Dr. Alain Mangin, where he became familiar with regional karstology (Ravbar 2023). He then devoted his scientific work to speleology and karst research (Figure 1).

At the beginning of his work at the Karst Research Institute ZRC SAZU he helped to survey caves and later dealt with physical speleology and karst geomorphology. His dissertation dealt with recent fluvial sediments in caves (Kranjc 1986a). He was less concerned with theoretical issues than with regional karstology, karst hydrology, ecological issues, protection and conservation of karst and caves, and karstological terminology. In later years he devoted more time to the history of karstology, especially to the historical significance of Slovenian karst (<https://www.sazu.si/clani/andrej-kranjc>).

He also dealt with flooding in karst areas and published several regional speleological and karstological studies. He paid special attention to the Škocjan Caves and their protection, the history of karst research and the development of karstology. He edited several monographs, served on editorial boards of national and foreign journals, and was editor of the central karstological journal *Acta Carsologica*, listed in the Scientific Citation Index, for nearly two decades. He was invited to lecture at universities or conferences on several occasions (Figure 2). His scientific and professional bibliography represents an important contribution to the knowledge of Slovenian karst, to the development of karstology and its terminology. An evaluation of his work can be found in the following chapters.

3 Contribution to geography

Andrej Kranjc's research work covers a wide range of content related to karst geomorphology and hydrology. His main professional articles have been published in *Acta Carsologica*, *Acta geographica Slovenica*

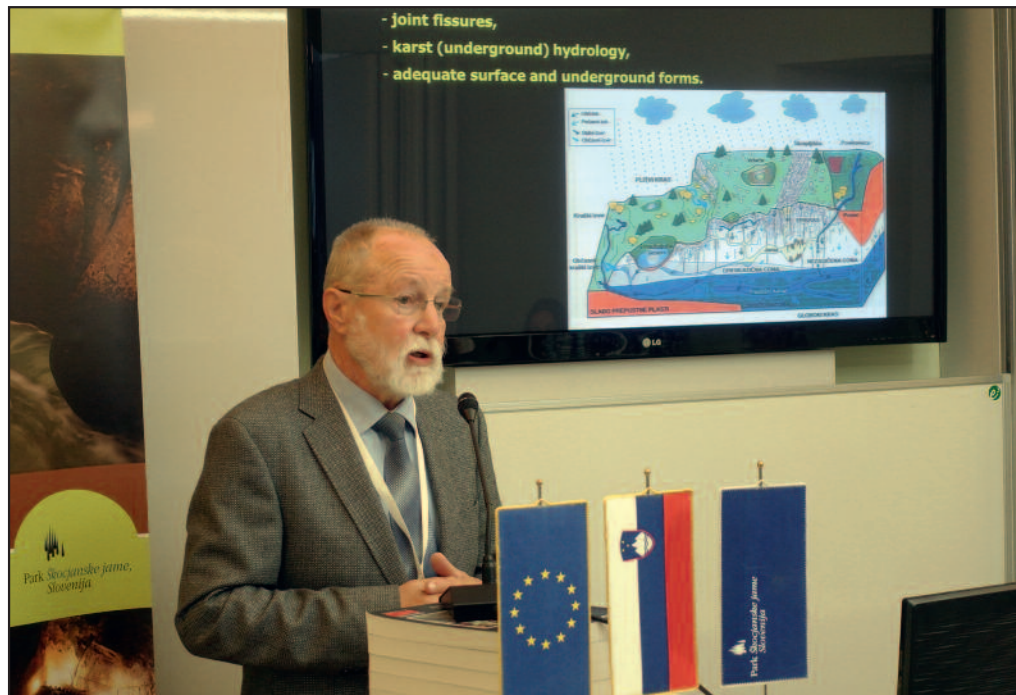


Figure 2: Kranjc as a keynote speaker at the international conference SOS Proteus, organized on the occasion of the 250th anniversary of the taxonomic description of *Proteus anguinus* in the Škocjan Caves Park in 2018.

(Geografski zbornik), Geografski vestnik (Geographical Bulletin), Planinski vestnik, Proteus, and smaller contributions are collected in Naše jame and in the French journals Karstologia and Spelunca. He also frequently presented the results of his work at national and foreign congresses and symposia. His bibliography lists more than 1,400 units (https://bib.cobiss.net/bibliographies/si/webBiblio/bib301_20230324_093725_00986.html).

3.1 Karst geomorphology and hydrology

His earlier research on karst and caves was connected with the creation of the Basic speleological map of Slovenia, which was carried out in the period 1972–1978 within the framework of the Karst Research Institute ZRC SAZU. The map was gradually prepared for the whole of Slovenia in order to encourage further systematic discovery of caves, more detailed speleological research and study of hydrological, geomorphological, and geological features of karst (Habič, Kranjc and Gospodarič 1973). By surveying the caves, a lot of information and data on the geomorphological evolution of the karst landscape were obtained. With this work, the authors contributed mainly to the subsequent improvement of knowledge about the karst surface, speleogenesis, and hydrology (Habič 1968; Gospodarič 1976; Gospodarič and Habič 1976; Janež et al. 1997).

In his master's thesis on the study of karst in Ribniška Mala gora, Kranjc analyzed the factors affecting the development of karst (Figure 3), especially underground. He compared the underground karst formations and determined the stages of karst and cave development depending on the direction and type of previous water drainage. He concluded that the vertical bifurcation between the Kolpa and Krka rivers is a relatively recent phenomenon and that the reason for this is the karst nature associated with the subsidence of the studied region (Kranjc 1981b).

In his early work he devoted himself mainly to the study of fluvial sediments in caves. In these works, he placed great emphasis on observing and measuring the transport of sediments. Similar studies had already been carried out abroad (e.g., Renault 1968), but in Slovenia, this type of work was considered ground-breaking. It determined the origin and role of fluvial sediments in speleogenesis. In the case of the Reka River, he dealt with the transport of solid particles through the karst underground of the Škocjan Caves and Kačna Cave (Kranjc 1982c; 1986b). He described how much of it is suspended load and how much is bedload in the form of sand and gravel. On this basis, he gave an estimate of erosion intensity. He also observed and compared the coarse suspension load of the Pivka, Nanošičica and Lokva rivers (Kranjc 1982a). He found that the suspended sediment load depends on the geological conditions in the catchment area of the river and the given hydrological conditions. These works formed the basis for later studies on speleogenesis and cave sediments (e.g., Gams 1983; Čar and Gospodarič 1984; Habič et al. 1989; Slabe 1995; Mihevc 2001; Zupan Hajna 2002).

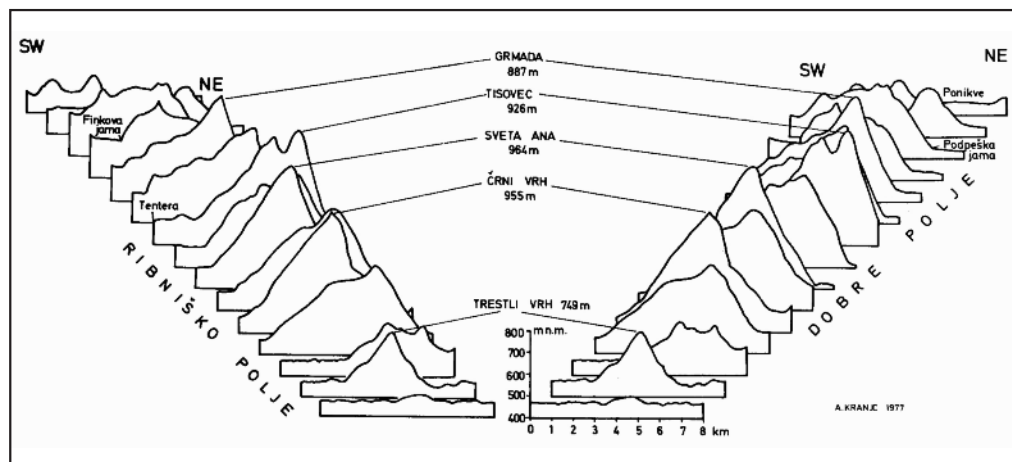


Figure 3: Cross-sections of peaks and slopes of the Mala gora Mountain (Kranjc 1981b).

Such studies have also proved useful for water use plans. An example is a study of contact karst at the transition from volcanic to carbonate rocks in the Ljubija River catchment, where he investigated suspension loading and related problems (Kranjc 1979b). In addition, he conducted petrographic, granulometric, morphometric, and other analyzes of sediments in the Babja jama Cave near Most na Soči and defined sedimentation processes in the cave (Kranjc 1981c). He also studied cave sediments in other caves, such as the Leška planina Shaft (Kranjc and Malečkar 1981).

He was also concerned with temperature measurements in caves, weathering of flowstone and the dynamics of dripstone fall (Kranjc 1974; 1983a; 1999; Kranjc and Opara 2002). He observed acid rain and its influence on underground karst processes. Using Postojna Cave as an example, he found that no accelerated corrosion processes are observed in the cave because the acidic water is neutralized on its way through the underground (Kogovšek and Kranjc 1988; 1989).

In addition, he devoted much of his work to the flooding of karst poljes and along sinking rivers. He described the flooding areas of Kočevje Polje, floods in Cerknica Polje, and along the Reka and Pivka rivers (Kranjc and Lovrenčak 1981; Kranjc 1981a; 1985a; 1985b; Kranjc and Mihevc 1988). These articles discuss

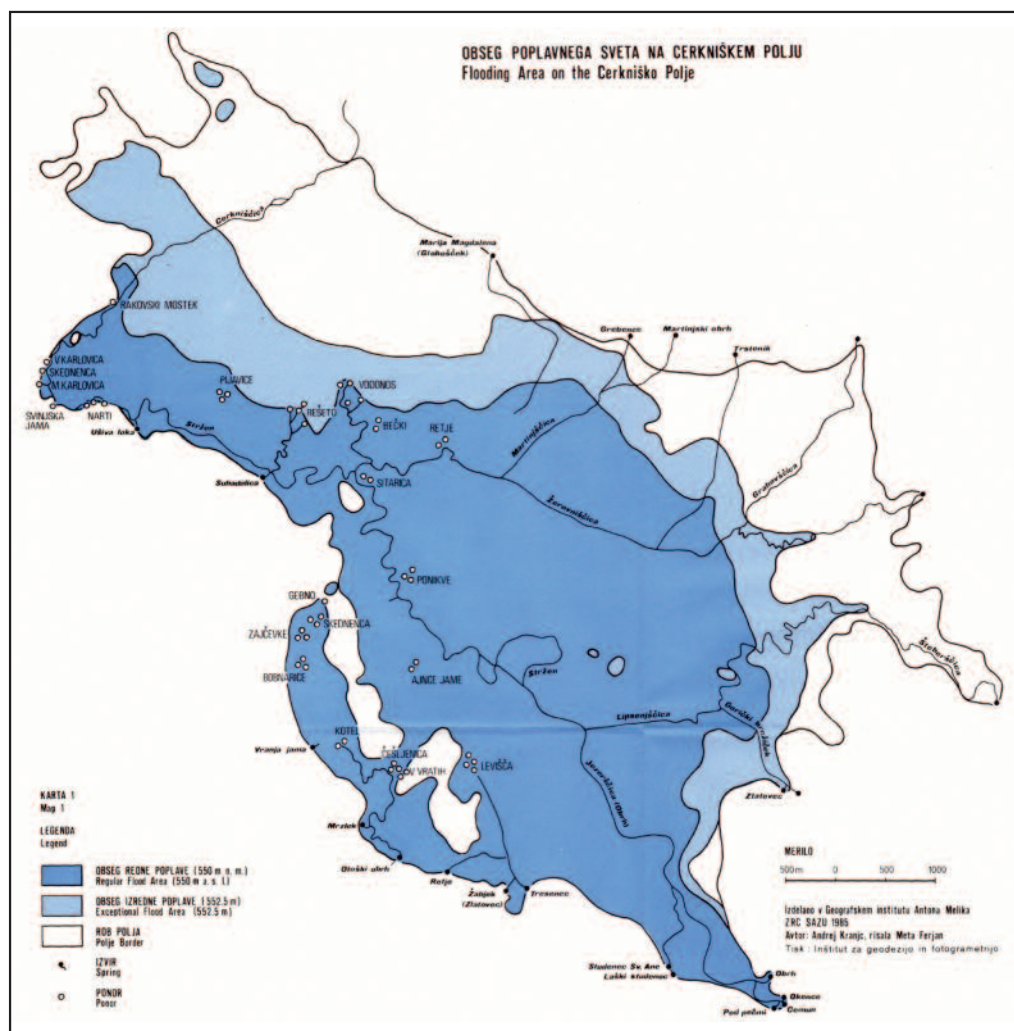


Figure 4: The map of the extent of floods in Cerknica Polje (Kranjc 1985a).

in detail the mechanism and characteristics of floods, as well as hydrological and pedological characteristics of the studied areas. The impact of floods on the life and activities of the population is given special attention. In the case of Cerknica Polje, the emphasis is on the evaluation of historical sources and plans for drainage, land reclamation, and the creation of a permanent lake (Figure 4). The work has been useful for much further research (Smrekar 2000) and, in particular, for the subsequent identification of inundation areas within the poljes and intermittent lakes for the purposes of ephemeral flood mapping (Ravbar et al. 2021). Within the framework of flood research, Kranjc has also been involved in the evaluation of regulatory and melioration measures, as well as in the assessment of damage caused by floods.

3.2 Regional karstology and protection initiatives

Kranjc also studied the geomorphology of various karst regions. He devoted much attention to the Lower Carniola Karst and published the results of his earlier karstological and speleological studies in a booklet *Dolenjski kraški svet* (Kranjc 1990a; Figure 5). More detailed studies include, for example, the study of the karst of Kočevje Polje (Kranjc 1972b), the karst in the vicinity of Velike Lašče, in which he describes the shallow dolomitic karst, and others (Kranjc and Kogovšek 1987; Kogovšek and Kranjc 1992). He also published numerous cave descriptions (Kranjc 1972c; 1979a; 1982d; 2001) and papers dealing mainly with the Alpine karst (Kenda and Kranjc 1978; Kranjc 1979a; 1982b; 2004a), karst caves types near the Triglav Mountain, and particularly ice caves (Kranjc 1976). He wrote a short paper on karst in Canada and several works on karst in southern China (Kranjc 1983b; Kogovšek et al. 1999).

In the later years of his research activity, Kranjc devoted himself to ecological issues, conservation of karst and its resource exploitation (Kranjc 1990b; 1992; 2002c; 2005). As part of his international activities, he was mainly active in the field of tracing techniques. Between 1992 and 1995, extensive research on contamination transport in karst took place on the Trnovo-Banjšice and Nanos plateaus. Based on field work, various tracers and models were tested. Kranjc summarised the results of this research in a special monograph (Kranjc 1997c). He also participated in various activities of COST projects on hydrogeological aspects

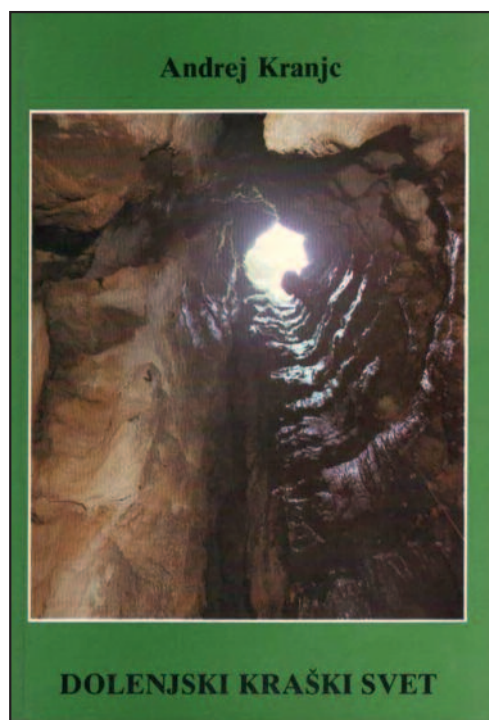


Figure 5: Kranjc is the author of numerous books, of which the booklet *Dolenjski kraški svet* (Karst of Lower Carniola) is noteworthy (Kranjc 1990a).

of groundwater protection in karst areas and on mapping of vulnerability and risk for protection of carbonate aquifers. Using the Škocjan Caves and Lunan Stone Forest as examples, he devoted considerable attention to the protection and management of the karst natural and cultural heritage (Kranjc and Liu 2001).

3.3 History of karstology and karst terminology

Kranjc also engaged in the history of karstology and speleology (Kranjc 1997a) and wrote articles on Slovenian speleology, which had a broader character (Kranjc 2002a). He was a good connoisseur of the works of Janez Vajkard Valvasor, especially the geomorphological, karstological and speleological contents in his work *Slava Vojvodine Kranjske* (The Glory of the Duchy of Carniola). He also studied the works of Baltazar Hacquet, whose *Oryctographia Carniolica* he considered a continuation or improvement of the Valvasor's *Slava* (Kranjc 1990c; 2006). He also processed the contributions of others who dealt with karstology, e.g., Freyer, Kircher, Martel, or the contributions of Habe, Gams, and others to the development of karstology (e.g., Kranjc 1997b; 1997d; 2002b; 2013; 2020).

Kranjc also dealt with the history of deforestation and reforestation in the Dinaric Karst (Kranjc 2009b; 2012). He contributed to karstological terminology and discussed the origin of the names *Kras* and *Dinara*, as well as terms such as *karst*, *sig*, *estavelle*, *doline*, and *tiankeng* (Kranjc 1972a; 1980; Mikoš et al. 2002; Kranjc 2009a; 2011; Kranjc and Panisset Travassos 2018). Kranjc was also the author of numerous encyclopedia articles. Among others, he contributed extensive geographic descriptions of the Dinaric Karst (Kranjc 2004b).

4 Strengthening karstology

In addition to his substantial contribution to science, he has promoted karst in many activities and roles. Throughout his service, Andrej Kranjc was employed at the ZRC SAZU Karst Research Institute (Figure 6). Over time, he progressed from assistant to scientific advisor, which he became in 1995. Between 1988 and 1995, he was the director of the Institute, but he does not remember this period very fondly due to constant financial uncertainty (Ravbar 2014).

Andrej Kranjc loved to travel. In his everyday life he was torn between Ljubljana and Inner Carniola Region, where, besides the working environment, the karst and the caves irresistibly fascinated him. He was especially attracted by the first-time experience or discovery, the beauty and tranquilly. According to the records in the Cave Registry (2023), he contributed records of about 150 caves and participated in the exploration of almost 200 caves. However, he probably visited and explored even more caves, because cave registers were not always kept. He claimed to have visited at least 600 Slovenian caves, and in total, including caves in other parts of the world, he had visited between 1,000 and 1,200 caves, of which he was very proud (Ravbar 2014). In addition to his professional commitments, he often took long trips with his family in his private life.

As a travel enthusiast, he visited various karst areas on six continents. He was an excellent connoisseur of karst all over the world, especially Chinese karst. Traveling with him was always stimulating. He looked forward to every trip, never grumbled, and brought a positive spirit to the team. He admired the beauty of nature, the hospitality of the locals and the deliciousness of the food, even when the trip was very tiring.

Kranjc was one of the first to see the perspective of Slovenian karstology in the international context. With the support of the Slovenian National Commission for UNESCO, he was the initiator of the world-famous International Karstological School (IKS), which for three decades has been the largest annual meeting of karstologists in the world (<https://iks.zrc-sazu.si/en>). The IKS is dedicated to a specific topic each year and has provided a wide range of relevant contributions to science. Every year there are between 100 and 150 participants, often over 200 from many countries around the world. In total, more than a thousand people from 63 countries attended the event (Mulec et al. 2023).

In addition, Kranjc always unselfishly shared his extensive expertise with the operators of tourist caves, landscape and regional parks, and other initiatives. For many years, he was the chairman of the Škocjan Caves Expert Council and worked closely with the administrators of Postojna Cave. From 2009 to 2013, he was a member of the academic committee of the UNESCO International Research Centre on Karst,



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Figure 6: Kranjc (fourth from left) with his wife Maja Kranjc and his colleagues Janja Kogovšek, Tadej Slabe and Stanka Šebela from the Karst Research Institute in China in 1999.

based in Guilin, China, assisting it in conducting a number of academic exchanges and providing ideas and suggestions for long-term development.

Kranjc has held numerous leading positions in the field of geographical and karstological publications. Since 1989 he has been a member of the editorial board of the central Slovenian karstological journal *Acta Carsologica*. Between 1993 and 2010 he was its editor-in-chief, later co-editor (Gabrovšek and Ravbar 2023). Under his editorship, the journal experienced an upswing, gained international recognition, and the number of published papers increased. In the 1990s, the electronic edition of *Acta Carsologica* was introduced, an important step that allowed unlimited and even remote access to all articles. As a result, *Acta Carsologica* was included in the Web of Science and Scopus databases in 2006 (Gabrovšek and Ravbar 2015). However, Andrej Kranjc was also editor-in-chief (1991–1993) of the central Slovenian geographical journal *Geografski vestnik* (Geographical Bulletin) and a member of the editorial boards of numerous national and international (from Brazil, Egypt, France, Italy, China, Hungary, Germany, Poland, Russia, and Slovakia) scientific and professional journals in the fields of karstology, speleology, and environmental protection.

Kranjc has been a member of several international professional associations, including the Karst Commission of the International Geographical Union, which he chaired from 2008 to 2016, and several other commissions of the International Geographical Union (e.g., the Commission on Degradation and Desertification and the Commission on the History of Geography). He also served as vice president of the Slovenska Matica (Slovenian Society) for Natural Sciences from 2018 to 2022. In addition, he was a member of the Commission on the History of Speleology of the International Speleological Union, the Karst Commission of the International Association of Hydrogeologists, the Working Groups on Caves and Karst of the World Commission on Protected Areas of the World Conservation Union, the International Association for Quaternary Research, the French Karstological Association (Association Française de Karstologie), and others.

In 1998, he was elected assistant professor of physical geography at the Faculty of Arts in Ljubljana, where he taught karst geography until 2000 (Ogrin 2019). In 2008 he was elected full professor and a year later professor emeritus of karstology at the University of Nova Gorica. He supervised a number of theses

and six dissertations by doctoral students from around the world (Ravbar 2007; Čalić 2009; Lučić 2009; Panisset Travassos 2011; Breg Valjavec 2012; Griffiths 2020). He was also a member of the Senate of the University of Nova Gorica.

Thanks to the vision and perseverance of Andrej Kranjc, the Postgraduate Study Programme of Karstology was established in 2001, the only comprehensive study programme in karstology in the world and the only one in which the student receives the title of Doctor of Science in the field of karstology. The study programme was initially established at the Faculty of Humanities in Koper. Since 2003, the Doctoral study programme Karstology has been conducted under the auspices of the University of Nova Gorica (then Polytechnic), of which Kranjc was the director. The Doctoral study programme Karstology has been recognised as a UNESCO chair since 2014 (<https://www.ung.si/en/schools/graduate-school/programmes/3KR>). Nearly thirty doctoral students from around the world have already completed the Programme (Mulec et al. 2023).

Kranjc was awarded several times for his achievements. Of particular note are the Golden Plaque and the Anton Melik Prize of the Association of Slovenian Geographers, which he received in 2004 and 2011, respectively. He also received the Prešeren Award for Students, the Order of the Knight of the Academic Palm (Chevalier dans l'Ordre des Palmes Académiques) in 1997, the Award for Research Achievements in the Development and Strengthening of the Identity of Slovenes in Slovenia, which he was the first to receive in 1998, and others.

In 1995 he was elected associate member and in 2001 full member of the Slovenian Academy of Sciences and Arts (SAZU). From 2008 to 2014 he was its secretary general and from 2014 to 2017 its vice president. At SAZU, he also served as chairman of the Council for Environmental Protection. In March 2015, he was appointed a member of the European Academy of Sciences and Arts. In this capacity he has strongly promoted and strengthened karstology.

Kranjc was also a great specialist of international karst literature, which is not surprising, since books were another passion of his. He often told that he had books practically everywhere at home. He had inherited many of them from his father-in-law, but he always found it difficult to resist the temptation to buy another book. He was also an avid postcard collector. His collection included more than 250,000 pieces, which he carefully catalogued. He also collected stamps with karst and cave motifs.

Andrej was modest by nature, he never put himself in the limelight. His personality was characterised above all by openness, thoughtfulness and kindness. He was a man of enormous energy and willpower. Above all, he avoided conflict. In his work he was always precise and thorough. He never boasted, emphasised his many positions and honours, or underlined his accomplishments in any way. He was not only an outstanding scientist, but also a patient teacher and a wonderful colleague. He believed in young people and, was always very supportive.

5 Conclusion

In the last quarter of the 20th century and in the first two decades of the 21st century, Andrej Kranjc had a strong influence on Slovenian geography and contributed to spreading the reputation of Slovenia as a karst country and as a leader in karstology as a science. At the beginning of his research activity he was engaged in physical speleology and karst geomorphology. Then he turned to the study of regional karstology and karst hydrology, which led him to issues of karst protection and conservation. In later years he devoted more time to the history of karstology, especially the historical significance of Slovenian karst and karst terminology. With his research and professional work Andrej Kranjc has contributed to increasing Slovenia's competitiveness and innovation in the field of natural heritage protection.

Kranjc's work has left an indelible mark on the generations of geographers and karst researchers he has inspired, supported, and influenced, and from whom we have learned about karst, as well as on future generations. He has paved the way for us, pointed out directions for future research, and hinted at others as well. This article rounds out his scholarly work by recalling Andrej's contribution to geography and karstology, and introducing the reader to the person and work of our esteemed colleague.

ACKNOWLEDGMENT: This paper was prepared within the framework of the national research programme Karst Research, No. P6-0119, financially supported by the Slovenian Research and Innovation Agency. The author was a student and colleague of Andrej Kranjc and will always be grateful to him for his encouragement and support throughout her professional career.

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