

CREATING NEW OPPORTUNITIES FOR AN OLD MINING REGION: THE CASE OF IDRIJA (SLOVENIA)

STVARANJE NOVIH MOGUĆNOSTI ZA STARU RUDARSKU REGIJU: PRIMJER IDRIJE U SLOVENIJI

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Summary

Five hundred years of mercury mining in the town of Idrija in western Slovenia resulted in a highly polluted and degraded landscape. In recent decades and especially since the closure of the mine in the mid-1990s, the town experienced a somewhat successful transition into other more environmentally friendly industries. The mine itself underwent a transition into a museum and, together with the wider region, became a »geopark« and a UNESCO World Heritage Site.

Key words: regional development, mercury, pollution, cultural heritage, UNESCO, Idrija, Slovenia

Ključne riječi: regionalni razvoj, živa, zagađenje, kulturna baština, UNESCO, Idrija, Slovenija

1. HISTORICAL OVERVIEW: IDRIJA AS THE SECOND-LARGEST MERCURY MINE IN THE WORLD

Mercury and its derivatives have been used since antiquity for ointments, in cosmetics and jewelry making, and as a pigment and an ingredient in pharmacopoeia. However, at that time only small quantities of mercury were needed.¹ In the mid-sixteenth century, a large-scale amalgamation process for refining silver was developed by the Spaniard Bartolomé de Medina (1527–1580). This invention made mercury the key element in the silver and gold extraction systems; hence its production heavily influenced the European economy.² Mercury was also later used in the chemical industry, agriculture, the war industry, medicine, and the electrical industry. It was one of the most versatile metals for industrial use for centuries, but it has gradually been replaced by less toxic substitutes.³

Over the last half millennium, the town of Idrija (Figure 1 and 2) was one of the major European exporters of mercury. The discovery of mercury ore in 1490 and its exploitation proved decisive for Idrija's

¹ Heritage of Mercury: Almadén and Idrija, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

² Castillo Martos, M., Lang, M. F. 1995: Metales preciosos: Unión de dos mundos: Tecnología, comercio y política de la minería y metalurgia iberoamericana. Sevilla, Muñoz Moya y Monraveta Editores, 224 p.

³ Leskovec, I., Peljhan, M. 2009: Idrija: Zgodba o petstoletnem srebrnem studencu. Idrija, Rudnik živega srebra, 86 p.

economic development, especially for its early industrialization.⁴ At that time, Idrija was under Venetian rule but mining rights were also granted to the Germans, who brought their mining technology to the town.⁵ After the war between the Venetians and the Habsburgs at the beginning of sixteenth century,⁶ the mine was nationalized in 1575 and came under the direct administration of the Habsburg court. At that point large-scale expansion and modernization of the company began.⁷ During its five hundred years of operation, the Idrija mine produced 147,000 tons of mercury, accounting for 13% of global output.⁸ The value of mercury and its transportation routes varied with regard to production circumstances at the world's largest mercury mine in Almadén, Spain, international political agreements, the importance of major European ports, and the global demand for mercury, especially in the Americas.⁹

Trading mercury was a risky business. The largest southern German and Venetian trading companies already traded this valuable metal in the sixteenth century. These companies entered into monopoly contracts with entrepreneurs and the region's noblemen to transport large quantities of mercury. Competition from the Spanish mercury mines, high excise duties, road tolls, and the high costs of insurance for transporting the metal overseas often resulted in uncertainty for the Idrija mine, and those that traded in it often recorded losses. The merchants were thus in danger of going bankrupt if they did not cancel their contracts at the right moment; consequently Idrija's entrepreneurs had a difficult time finding new merchants to take up the failed business. Such interruptions in trade also affected the miners; they lost their jobs and payment for their work.¹⁰

Until the mid-seventeenth century, Idrija's mercury was transported mainly through the town of Tolmin in western Slovenia and Cividale in eastern Italy to the port of Venice, and from there exported overseas. The increase in transport tariffs in Venice gradually resulted in a new route towards the north, via Salzburg toward the port of Amsterdam.¹¹ Over time, Trieste became a principal port for exporting Idrija's mercury. From 1736 onwards, all of the overseas trade took place from there.¹² These routes served for more than exporting mercury; from the opposite direction, important supplies and food were brought to Idrija. Newcomers, travelers, miners, mining experts, scientists, and medical experts came to the town, resulting in the production and exchange of knowledge. Continuous modernization of mining infrastructure (expansion of the mine, new shafts, and mine buildings) and technological development, closely related to accessing ore deposits, caused constant landscape changes in Idrija.¹³

The mercury ore deposit is below the center of the town of Idrija (Figure 2). The entire mine network is 700 km long, spread across fifteen levels, 382 m deep.¹⁴ Mining was closely associated with water. Water was the most valuable energy source, but at the same time it caused many difficulties by breaking into the shafts and hindering ore extraction. A pumping system had to be built to pump pit water out of the shafts and to raise and lower cargo into and out of the mine. These pumps were driven by water from the dammed Idrijca River through a 3.5 km millrace that powered a large water wheel 13.6 m in diameter

⁴ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.

⁵ *Heritage of Mercury: Almadén and Idrija*, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

⁶ Košir, M. 2011: Beneška vojna – evropska vojna za vpliv v Italiji (1508–1516). *Idrijski razgledi*, 56 (1), pp. 26–55.

⁷ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.

⁸ Leskovec, I., Peljhan, M. 2009: *Idrija: Zgodba o petstoletnem srebrnem studencu*. Idrija, Rudnik živega srebra, 86 p.

⁹ *Heritage of Mercury: Almadén and Idrija*, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

¹⁰ *Ibid.*

¹¹ Leskovec, I., Peljhan, M. 2009: *Idrija: Zgodba o petstoletnem srebrnem studencu*. Idrija, Rudnik živega srebra, 86 p.

¹² *Heritage of Mercury: Almadén and Idrija*, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

¹³ Leskovec, I., Peljhan, M. 2009: *Idrija: Zgodba o petstoletnem srebrnem studencu*. Idrija, Rudnik živega srebra, 86 p.

¹⁴ Herlec, U., Poljanec, F., Rečnik, A., Režun, B. 2006: *Rudišče živega srebra v Idriji*. Scopolia, Suppl. 3, pp. 15–27.

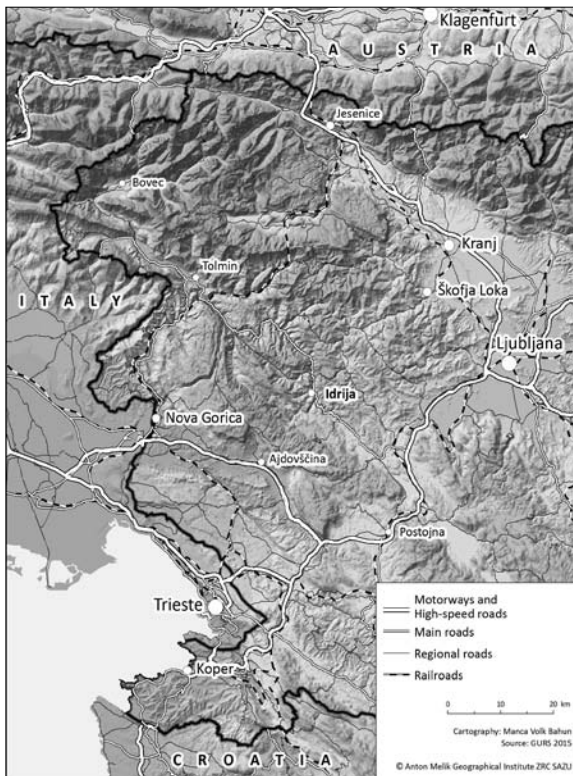


Figure 1: Idrija is located in the narrow Idrijca Valley in western Slovenia.



Figure 2: Idrija around 1750 (source: Balthasar Hacquet, *Oryctographia Carniolica II*, 1781).

(known as the *kamšt*).¹⁵ This waterwheel had a rotation speed of four to five turns a minute and pumped three hundred liters of pit water per minute from 283 meters below the surface.¹⁶

Wood was another essential resource for Idrija's economy. Five hundred years of mining required vast quantities of timber for the mine's architecture, supporting pillars, machines, and smelting ore, as well as for supplying the town's residents.¹⁷ After the nearby forests had been cut, the forests from the hilly surroundings were exploited. For this purpose, the first logging sluices (known as *klavže*) were built on nearby rivers in the sixteenth century (Figure 3). The largest ones preserved can be found on the Idrijca River. Timber was piled in the river and, when the sluiceways were opened, the released water drove the timber downstream to the valley, where it was retrieved from the water for use.¹⁸ The sluices were associated with certain environmental effects, such as the formation of reservoirs behind them or artificial flood waves, which had great erosion force after the sluiceways were opened.¹⁹ The reservoir with the largest sluice was 785 m long and contained 210,000 m³ of water. When the sluiceways were opened,

¹⁵ Pipan, P. 2012: Kamšt. In: DEDI - digitalna enciklopedija naravne in kulturne dediščine na Slovenskem. URL: <http://www.dedi.si/dediscina/462-kamst> (20. 12. 2013).

¹⁶ Heritage of Mercury: Almadén and Idrija, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

¹⁷ Zelenc, A. 2000: Rudniške elektrarne. Idrijski razgledi, 45 (2), pp. 69–77. Zelenc, A. 2001a: In vendar se giblje: katalog obnovljenih rudniških strojev in naprav. Idrija, Mestni muzej, 79 p.

¹⁸ Brate, T. 1985: Idrijske klavže. Kulturni in naravni spomeniki Slovenije, 136. Maribor, Obzorja, 22 p. Kladnik, D. 2010: Klavže na Idrijci. In: DEDI - digitalna enciklopedija naravne in kulturne dediščine na Slovenskem. URL: <http://www.dedi.si/dediscina/385-klavze-na-idrijci> (20. 12. 2013).

¹⁹ Zwitter, Ž. 2014: Okolje na Kranjskem v 17. stoletju po Slavi vojvodine Kranjske. In: Studia Valvasoriana: zbornik spremenih študij ob prvem integralnem prevodu Die Ehre Deß Hertzogthums Crain v slovenski jezik. Ljubljana, Zavod Dežela Kranjska, p. 642.



Figure 3: Logging sluices were built on rivers from the sixteenth century onwards for moving timber downstream for use by the mine. The photo shows the Brus Sluice (also known as the Belca Sluice; photo: Bojan Erhartič).

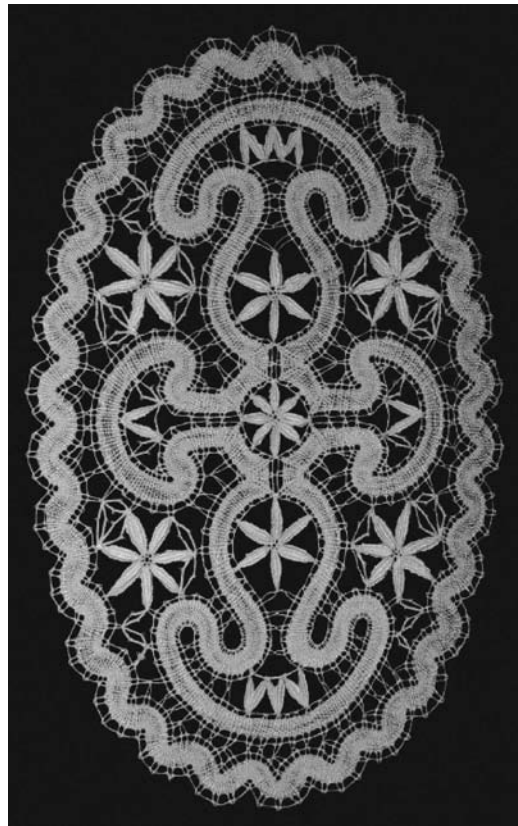


Figure 4: Idrija lace (source: Idrija Lace School).

it emptied in 15 to 20 minutes and approximately 13,000 m³ of timber could be driven downstream to Idrija in a single release.²⁰ The released water and timber caused a tremendous booming noise along the valley. Before the timber was released downstream, all the obstacles were removed from the riverbeds: large rocks were pulled onto the banks or blown up, fallen trees were removed, and the riverbanks were reinforced, so that they did not collapse while driving logs. Locust and willow trees were planted along the riverbanks to reduce gravel erosion. The flood wave carried a great amount of gravel.²¹ Piling the wood and transporting it also affected the river fauna, and historical sources report the complete devastation of the fish population downstream from the sluices. To compensate for this loss, a special trout farm was established in the vicinity and its hatchlings were transferred back into the rivers every year. Riverside meadows and fields along the logging route were regularly flooded, covered in wood and river sediments; therefore the owners received financial compensation.²²

From nationalization in 1575 until the First World War, the Idrija mine was one of the most profitable state-owned companies.²³ Using steam engines, mechanical drilling, improved furnaces, and electrifica-

²⁰ Čar, J. 1991: Klavže. In: Enciklopedija Slovenije, 5. Ljubljana, Mladinska knjiga, p. 90.

²¹ Mohorič, M. 2006: Vodni transport lesa in idrijski rudnik. Idrijski razgledi, 51 (1-2), pp. 80–81.

²² Mazi, S. 1955: Klavže nad Idrijo. Ljubljana, Tehniški muzej Slovenije, 70 p.

²³ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.



Figure 5: *Idrija lace makers during the interwar period (source: Idrija Municipal Museum).**

* Terpin Mlinar, M. 2010: Idrijska čipka. In: Na prelomnici: razvojna vprašanja Občine Idrija. Ljubljana, Založba ZRC, p. 199.

tion, the facilities maintained high production and achieved a record in 1913 with 820 tons of mercury.²⁴ Two experts from Idrija, Josip Čermak and Vincenc Špirek, designed a well-known furnace for smelting mercury ore that was resistant to the extremely high temperatures. At that time, the Čermak–Špirek furnace was the apex of mercury-smelting technology and was also applied to the world's largest mercury mine in Almadén.²⁵

Idrija was a place where many important scholars worked and contributed to the technological advancement of the town and Europe as a whole. Their work was manifested in the early development of education, the arts, and science in Idrija.²⁶ Early establishment of educational facilities shows that a successful school system requires not only money and a regulatory basis, but also support of a local society that appreciates greater general knowledge and practical training for young people. A Protestant primary school was opened in 1581, a technical metallurgical and chemistry school operated from 1763 to 1769, and later there was also a mining primary school. The first Slovenian intermediate secondary school was established in Idrija in 1901.²⁷

The development of the natural sciences in Idrija traces its roots to the sixteenth century. One scientist that left his mark on Idrija was Giovanni Antonio Scopoli (1723–1788), a polymath of global importance, a pioneer of European medicine at the workplace, and an important name in botany, geology, mineralogy, and chemistry.²⁸ Another prominent individual was Balthasar Hacquet (1739/1740–1815), who lived in Idrija between 1766 and 1773. He was a doctor, surgeon, and world-class naturalist. Idrija is also known for its early and well-organized healthcare and social care systems for workers.²⁹

Although Idrija's miners earned similar wages to those working in other Austrian mines, they were worse off. Idrija lacked a fertile hinterland and food had to be imported from distant places. On many occasions, the basic wages did not even suffice for the bare necessities and only side jobs made it possible for miners to get ahead. Many miners worked as carpenters, bricklayers, and joiners, but from the

²⁴ Leskovec, I., Peljhan, M. 2009: Idrija: Zgodba o petstoletnem srebrnem studentu. Idrija, Rudnik živega srebra, 86 p.

²⁵ Heritage of Mercury: Almadén and Idrija, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

²⁶ Ibid.

²⁷ Pavlič, S. 1993: Idrijsko šolstvo skozi stoletja. In: Idrijska obzorja: Pet stoletij rudnika in mesta. Idrija, Mestni muzej, pp. 101–112.

²⁸ Heritage of Mercury: Almadén and Idrija, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

²⁹ Pfeifer, J. 1993: Zgodovinski razvoj medicine dela pri idrijskem rudniku. In: Idrijska obzorja: Pet stoletij rudnika in mesta. Idrija, Mestni muzej, pp. 93–100.

seventeenth century onwards the most common additional income came from lace (Figure 4) created by miners' wives (Figure 5).³⁰

After the Second World War, the mine declined due to a drop in mercury prices on the world market and a decline in ore quality.³¹ The Idrija mercury mine was one of the oldest operational mines in Europe until 1988, when a gradual closure process was launched.³² The closure of the mine coincided with the collapse of communism and the breakup of Yugoslavia.

2. ENVIRONMENTAL IMPACTS OF MINING

Archeological finds indicate that the first practical application of cinnabar³³ was associated with its color; for example, in prehistoric cave drawings. The first advanced cultures used cinnabar primarily for its intense red color. Mercury was found in Egyptian tombs and was most likely used for religious rituals. In the first century BC, mercury was extracted by roasting mercury ore. In the Middle Ages, mercury was also used for alchemy and medicinal purposes.³⁴

The first reports of miners poisoned by high mercury concentrations go back to the sixteenth and seventeenth centuries, when working hours also began to be shortened for miners working at more exposed sites. However, the awareness of the impact of mining and ore processing on the natural environment developed considerably more slowly.³⁵

With regard to the impact on the natural environment, one should distinguish between primary or natural »pollution,« in which special natural conditions form due to the mercury-bearing rock on the surface, and secondary or human-caused pollution, which can have a severe environmental impact on people and the environment. Even the two simple mercury extraction procedures of rinsing and roasting ore caused intense uncontrolled pollution around the rinsing and roasting sites; roasting polluted the air and large quantities of mercury were rinsed into the surrounding streams.³⁶ The roasting residues were initially discarded around the roasting sites; later on, they were used for filling various relief depressions, and in the nineteenth century the majority of mining waste was discarded on the banks of the Idrija River, which flushed it away regularly when the water was high. Some of this waste was used for building and surfacing roads, and partly for construction.³⁷

The well-known alchemist and physician Theophrastus von Hohenheim, better known as Paracelsus, also spent two years in Idrija (from 1523 to 1524) and wrote the following about Idrija in his book on mining diseases:³⁸ »Everyone that lives there is bent and paralyzed, partly asthmatic and partly chilled through, without hope of ever being completely healthy again.« In the first half of the eighteenth century, the German travelogue writer Georg Keyssler wrote the following on the environmental impact of Idrija

³⁰ Batista, E. 2010: Idrijska čipka. DEDI - digitalna enciklopedija naravne in kulturne dediščine na Slovenskem. URL: <http://www.dedi.si/dediscina/46-idrijska-cipka> (20. 12. 2013).

³¹ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp 101–122.

³² Heritage of Mercury: Almadén and Idrija, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

³³ Mineral of mercury sulphide; Pavšič, J. (ed.) 2006: *Geološki terminološki slovar*. Ljubljana, Založba ZRC, p. 51.

³⁴ Čar, J., Dizdarevič, T. 2003: Pisna poročila o vplivu rudarjenja na naravno okolje v Idriji do konca 18. stoletja. *Idrijski razgledi*, 48 (1), p. 14.

³⁵ *Ibid.*, p. 15.

³⁶ *Ibid.*, pp. 18–19. Dizdarevič, T., Čar, J. 2009: Zgodovinski opisi posledic pridobivanja in predelave živosrebrne rude na okolje v Idriji od 16. do prve polovice 20. stoletja. *Idrijski razgledi*, 54 (2), p. 48.

³⁷ Kobal, A. B. 1995: Vplivi rudnika živega srebra na okolje in prebivalce v Idriji. *Idrijski razgledi*, 40 (1/2), p. 13.

³⁸ Čar, J., Dizdarevič, T. 2003: Pisna poročila o vplivu rudarjenja na naravno okolje v Idriji do konca 18. stoletja. *Idrijski razgledi*, 48 (1), p. 18–19. Dizdarevič, T., Čar, J. 2009: Zgodovinski opisi posledic pridobivanja in predelave živosrebrne rude na okolje v Idriji od 16. do prve polovice 20. stoletja. *Idrijski razgledi*, 54 (2), p. 45. Paracelsus 1527: *Von der Bergsucht und anderen Bergkrankheiten*. Neuburg.

ore roasting sites:³⁹ »the smoke from these furnaces is so destructive for the plants that no fruit tree grows nearby and even the cows do not touch the hay coming from the surrounding meadows. The local farmers do raise calves, but they are stunted in their growth. The workers at the smelting plant change every week, so that everyone takes their turn once a year.« After 1760, ore roasting was increasingly postponed to winter because it was believed that the roasting smoke was then less dangerous for the surrounding flora because the soil was covered in snow.⁴⁰ In the second half of the eighteenth century, the Idrija physician Balthasar Hacquet wrote a book on cattle poisoning,⁴¹ in which he wrote that the harmful effects of mercury and sulfur in Idrija sickened cattle when they ate fodder from locations near the roasting sites. He also mentions the cattle being poisoned by the water that ran through the piles of waste from the roasting or rinsing sites. Wastewater flowed into the Idrijca River, where he mentions fish kills.⁴²

In the seventeenth century and the first half of the eighteenth century, the first complaints were recorded regarding damage caused to sown crops, fodder, and cattle near the roasting sites. At the same time, efforts were taken to improve the roasting procedures, but these were mainly economic and had nothing to do with environmental awareness. It was not until the significantly increased production in the second half of the eighteenth century that the health and environmental conditions deteriorated to the extent that even the mine administration (Figure 6) had to admit that the gaseous emissions were harmful. In 1788, it began paying out damages to the landowners affected. This was probably the first »environmental annuity« in Carniola paid out regularly over the course of several years. A special mine committee was even established to assess the damage caused by smoke and determine eligibility for damages.⁴³ At the end of the eighteenth century, production decreased and new, more economical furnaces were introduced, which had a beneficial effect on environmental conditions (the sources indicate that people began raising sheep again) and subsequently also reduced the number of damage recipients. The payment of damages was cancelled after the major fire and production standstill in 1803. During the nineteenth century, landowners sought to reestablish the payment of damages, but the mine administration refused their claims with the »findings« that »the smoke primarily affects the environment through its stench« and that »experience shows that mercury vapors settle extremely quickly.« It was not until the 1880s that the mine administration acknowledged the harmful effects of gases and started paying annual »support« to the landowners.⁴⁴ Articles on environmental pollution published in various newspapers strongly influenced to this change of policy by the mine administrators.⁴⁵ There were several reports on two major fires (in 1803 and 1846) and the wastewater that then severely polluted the Idrijca River and killed the fish.⁴⁶ The contamination of the Idrijca also caused downstream contamination of the Soča River and even the Gulf of Trieste. It was only in the 1970s that depositing mine waste in the Idrijca was finally abolished.⁴⁷ The total quantity of mercury deposited in the alluvial sediments in the lower reaches of the Idrijca is estimated at over 2,000 tons, which amounts to approximately 5% of all the mercury released in the environment due to mining. In addition, it is estimated that approximately 2,500 tons of mercury

³⁹ Ibid., p. 20. Ibid., p. 46.

⁴⁰ Ibid., p. 21. Ibid., p. 46.

⁴¹ Hacquet, B. 1779: Beobachtungen und Heilungsmethoden einzelner Hornvierhkrankheiten, welche durch Gifte aus der drei Reichen der Natur verursacht werden. Sammlung nützlicher Unterrichte. Laybach, Joh. Friedrich Eger, Landschaftl. Buchdrucker.

It is interesting that the same author claimed exactly the opposite in his 1781 book *Oryctographia Carniolica*—that it is not unhealthy to live in Idrija (Čar, J., Dizdarevič, T. 2003: Pisna poročila o vplivu rudarjenja na naravno okolje v Idriji do konca 18. stoletja. *Idrijski razgledi*, 48 (1), p. 22).

⁴² Čar, J., Dizdarevič, T. 2003: Pisna poročila o vplivu rudarjenja na naravno okolje v Idriji do konca 18. stoletja. *Idrijski razgledi*, 48 (1), pp. 22–23.

⁴³ Ibid., p. 24.

⁴⁴ Dizdarevič, T., Čar, J. 2009: Zgodovinski opisi posledic pridobivanja in predelave živosrebrne rude na okolje v Idriji od 16. do prve polovice 20. stoletja. *Idrijski razgledi*, 54 (2), pp. 47, 49–50.

⁴⁵ Perger, H. 1873: Über die Schädlichkeit des idriener Hüttenrauches. *Österreichische Zeitschrift für Ber- und Hüttenwesen*, 21.

⁴⁶ Dizdarevič, T., Čar, J. 2009: Zgodovinski opisi posledic pridobivanja in predelave živosrebrne rude na okolje v Idriji od 16. do prve polovice 20. stoletja. *Idrijski razgledi*, 54 (2), p. 48.

⁴⁷ Ibid., p. 50.

was washed into the Gulf of Trieste.⁴⁸ In the central part of the Adriatic Sea, more than 500 km from the mine, approximately 50% of the total mercury content in marine sediments is still of Idrija origin.⁴⁹

During the entire operation of the mine, approximately 38,000 tons of mercury was released into the environment; predominantly in the form of vapors, roasting residues, and wastewater.⁵⁰ During the period of intense production (from 1968 to 1972), 7 to 10 tons of mercury was released from the smelting plants' chimneys.⁵¹ Mercury concentrations in the air⁵² were between 300 and 4,000 ng/m³ (but also up to 8,000 ng/m³); in approximately the same period, mercury concentration in the air in Ljubljana was 5 ng/m³. Mercury concentrations in water, plants, animals, and people were also elevated.⁵³ Concentrations in the Idrija water supply system were up to three times higher than after the mine was closed, and concentrations in various organs of adult Idrija residents that did not work in the mine were up to sixty times higher than elsewhere in Slovenia in the 1970s.⁵⁴ Another problem was also elevated concentrations of radioactive elements (U-238, Ra-232) within the roasting residues.⁵⁵

After production was stopped, mercury concentrations in the air and water decreased significantly, but mercury deposits in alluvial sediments and the soil have remained problematic.⁵⁶ Accordingly, pregnant women



Figure 6: *Gewerkenegg Castle in Idrija was built between 1522 and 1533. It was occupied by the mine administration for more than 400 years and now houses the Idrija Municipal Museum* (photo: Bojan Erhartič).*

* Gewerkenegg Castle – The Idrija Municipal Museum. URL: <http://www.muzej-idrija-cerkno.si/index.php/en/Locationexhibitions/permanent-exhibitions/grad-gewerkenegg.html> (10. 12. 2014).

⁴⁸ Žibert, G., Gosar, M. 2005: Koliko živega srebra je akumulirano v poplavnih sedimentih reke Idrijce? *Geologija*, 48 (1), p. 103.

⁴⁹ Gosar, M., Teršič, T. 2012: Environmental geochemistry studies in the area of Idrija mercury mine, Slovenia. *Environmental Geochemistry and Health*, 34 (1), p. 39.

⁵⁰ Kobal, A. B. 2009: Pregled spoznanj o vplivu delovanja rudnika in živega srebra na zdravje prebivalcev v Idriji v preteklih stoletjih. *Idrijski razgledi*, 54 (2), p. 21.

⁵¹ Kobal, A. B. 1995: Vplivi rudnika živega srebra na okolje in prebivalce v Idriji. *Idrijski razgledi*, 40, p. 13.

⁵² In areas remote from industry, atmospheric levels of mercury are about 2 to 4 ng/m³, and in urban areas about 10 ng/m³. This means that the daily amount absorbed into the bloodstream from the atmosphere as a result of respiratory exposure is about 32 to 64 ng in remote areas, and about 160 ng in urban areas (Air Quality Guidelines for Europe, 2000. WHO Regional Publications, European Series, 91. Copenhagen, World Health Organization, p. 157. URL: http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (5. 3. 2015)). The World Health Organization has estimated a tolerable concentration of 0.2 µg/m³ for long-term inhalation exposure to elemental mercury vapor, and a tolerable intake of total mercury of 2 µg/kg body weight per day (Exposure to Mercury: A Major Public Health Concern, 2007. Zürich, World Health Organization. URL: <http://www.who.int/phe/news/Mercury-flyer.pdf> (5. 3. 2015)).

⁵³ Kobal, A. B. 1995: Vplivi rudnika živega srebra na okolje in prebivalce v Idriji. *Idrijski razgledi*, 40, pp. 14–19.

⁵⁴ Kobal, A. B. 2009: Pregled spoznanj o vplivu delovanja rudnika in živega srebra na zdravje prebivalcev v Idriji v preteklih stoletjih. *Idrijski razgledi*, 54 (2), p. 27.

⁵⁵ *Ibid.*, p. 26.

⁵⁶ Gosar, M., Čar, J. 2006: Vpliv žgalnic živosrebrne rude iz 16. in 17. stoletja na razširjenost živega srebra v okolici Idrije. *Geologija*,

and children continue to be advised against eating fish from the lower reaches of the Idrija River and vegetables grown near the mine's smelting plant or ventilation shafts.⁵⁷

At least from the second half of the nineteenth century onwards, mining was accompanied by subsidence. Some buildings already had to be pulled down at the end of the nineteenth century. In the 1970s and 1980s, subsidence over the mine was up to 10 cm/year.⁵⁸

As shown, the five hundred years of mining have had a strong impact on people and the environment. In this regard, Paracelsus wrote *»how greatly Idrija's treasure turned into a poison for the people of Idrija.«*⁵⁹

3. ECONOMIC TRANSFORMATIONS

Mining in Idrija also experienced its ups and downs, just like any other industry. During the great economic boom at the end of the eighteenth century, when the mine worked together with the Spaniards for several decades, 1,350 workers produced 600 to 700 tons of mercury a year, which covered 5% of the total expenditure of the Habsburg Empire. The mine retained an important role among the most productive state enterprises up until the First World War; through ongoing modernization the mine maintained its high production rates and, as already mentioned above, it achieved a record in 1913 with 820 tons of mercury.⁶⁰

During the interwar period, when this region belonged to Italy, the mine stagnated, and it was completely disabled by air raids at the end of the Second World War. After several years of restoration, it managed to get running again and increased production to 500 to 600 tons a year, which lasted until the 1970s. That was when a crisis on the global mercury market began because mercury was increasingly replaced by substitutes that were friendlier to people and the environment, and mercury prices fell by a factor of eight. Due to unprofitable operations, production was even temporarily halted in 1977.⁶¹ After several years of discussing and analyzing development opportunities, a decision was reached at the end of the 1980s to gradually close the mine due to continued low prices of mercury and the fact that a large part of the mine was located immediately below the town and surface movements were recorded.⁶²

Even before the power of the mine began to wane, individual enterprises began operating in Idrija that gradually grew in importance over the following decades. At the beginning of the 1960s, Kolektor, a company producing commutators, was founded. It has now developed into a global corporation that supplies a large portion of the automobile industry and produces parts for household appliances and electric manual tools. Its development has been especially rapid in the past twenty years, during which it has turned into one of the leading international manufacturers of commutators.⁶³ From only a few dozen employees in 1963, it has grown into a corporation with more than twenty subsidiaries in Europe, the US, the Middle East, and Asia, which employ more than 3,000 people. Only in the past twenty years, the

49 (1), p. 100. Palinkaš, L. A., Pirc, S., Miko, S. F., Durn, G., Namjesnik, K., Kapelj, S. 1996: The Idrija mercury mine, Slovenia, a semi-millennium of continuous operation: an ecological impact. In: Environmental Toxicology Assessment. London, Taylor & Francis, pp. 317–341. Teršič, T., Biester, H., Gosar, M. 2014: Leaching of mercury from soils at extremely contaminated historical roasting sites (Idrija area, Slovenia). Geoderma, 226-227, pp. 213–222.

⁵⁷ Kobal, A. B. 2009: Pregled spoznanj o vplivu delovanja rudnika in živega srebra na zdravje prebivalcev v Idriji v preteklih stoletjih. Idrijski razgledi, 54 (2), p. 21.

⁵⁸ Dizdarevič, T., Čar, J. 2009: Zgodovinski opisi posledic pridobivanja in predelave živosrebrne rude na okolje v Idriji od 16. do prve polovice 20. stoletja. Idrijski razgledi, 54 (2), p. 50.

⁵⁹ Kobal, A. B. 2009: Pregled spoznanj o vplivu delovanja rudnika in živega srebra na zdravje prebivalcev v Idriji v preteklih stoletjih. Idrijski razgledi, 54 (2), p. 32.

⁶⁰ URL: http://www.rzs-idrija.si/zgodovina_vec.htm (1. 1. 2014).

⁶¹ Ibid. URL: http://www.rzs-idrija.si/zapiranje_vec.htm (1. 1. 2014).

⁶² Ibid.

⁶³ Kolektor 45 let. Informator, junij 2008. URL: <http://www.kolektor.com/resources/files/doc/komunitator/InformatorJunij08.pdf> (10. 12. 2014).

corporation increased its sales by a factor of fifteen, its profits by several hundred times, and its added value per employee by three to four times.⁶⁴

At the same time, another company important for Idrija was established: Hidria, a company that produces and assembles central heating, plumbing, and air conditioning. It has become one of the largest European corporations specializing in air conditioning, heating, and ventilation. It currently has thirty subsidiaries across the globe, employing over 2,000 people. Its R&D institutes create innovations that contribute to higher quality of life, comfortable living, and green mobility. The company has also focused on the automobile industry and is now an important provider of innovative solutions for car engines and vehicle steering systems, and hence an important partner of the majority of European car brands.⁶⁵ Thanks to its strong R&D focus, Hidria was declared Europe's most innovative company among the 15,000 companies vying for the 2013 European Business Awards.⁶⁶

Idrija managed to restructure itself from an old industrial (mining) town into a vital new industrial area due to the international profile generated by its mine and its inclusion in the global trade. Many additional factors contributed to the successful transformation of Idrija: extensive technical expertise (which was put to good use by local companies), openness to the rest of the world and welcoming many international experts, human resources, a strong local identity, and financial incentives for restructuring that the mine (in contrast to other Slovenian mining centers) received during the early mining crisis.⁶⁷

In addition to the rich technological heritage, it is also necessary to highlight the importance of the values that, according to research among the residents,⁶⁸ transformed Idrija and its residents into an environment focused on development and progress that helped Idrija become and remain a global economic center: technical expertise (Idrija had one of the most advanced mines, accumulating diverse knowledge from many European centers; e.g., Idrija was the world's leading knowhow and innovation center in ore smelting), flexibility, adaptability, quick response, openness to international markets, knowhow, and new ideas, the population's creativity (evidenced by numerous innovations during both the mining and industrial eras), and so on. Although new areas of economic activity arose, the people of Idrija continue to be open to the rest of the world and receptive to its influences. Specific historical development of the town seems to have resulted in the formation of a creative milieu described with characteristics such as openness to new ideas and knowledge, strong interpersonal relations, a high level of communication, solidarity, a strong identity and tacit knowledge, a sense of belonging, active participation in civil society, and intense face-to-face contacts.⁶⁹ Close connections to the global market for more than five centuries have shaped a resilient and creative community open to the influx of ideas and innovations.⁷⁰

⁶⁴ Rupnik, P. 2012: Že 50 let poganjamo prihodnost. Informator, december 2012, pp. 2–3. URL: http://www.kolektor.si/resources/files/doc/komunitator/informator_%20december12.pdf (10. 12. 2014).

⁶⁵ Hidria skozi zgodovino. URL: <http://si.hidria.com/si/o-nas/ozadje/> (10. 12. 2014).

⁶⁶ Hidria razglašena za najinovativnejše podjetje v Evropi (7. 6. 2013). URL: <http://si.hidria.com/si/o-nas/novice-dogodki/7191/detail.html> (10. 12. 2014).

⁶⁷ Kavaš, D., Koman, K. 2010: Razvoj in stanje gospodarstva v Občini Idrija. In: Na prelomnici: razvojna vprašanja Občine Idrija. Ljubljana, Založba ZRC, pp. 131–142.

⁶⁸ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122. Razpotnik Viskovič, N., Nared, J., Urbanc, M. 2008: Pogovor v kavarni: soočenje teorije in prakse. *Geografski vestnik*, 80 (1), pp. 119–126. Zumaglini, M., Nared, J., Alfarè, L., Razpotnik Viskovič, N., Urbanc, M. 2008: Participation process in regional development: DIAMONT's perspective. *Quaderni*, 52. Bolzano, Accademia Europea, 146 p. Razpotnik Viskovič, N., Urbanc, M., Nared, J. 2009: Prostorska in razvojna vprašanja Alp. *Georitem*, 12. Ljubljana, Založba ZRC, 94 p. Nared, J., Bole, D., Razpotnik Viskovič, N. 2014: Tradition and development: the case of Idrija, Slovenia. *Regions*, 293 (1), pp. 17–20.

⁶⁹ Fromhold-Eisbith, M. 1999: Das »kreative Milieu« - nur theoretisches Konzept oder Instrument der Regionalentwicklung? *Raumordnung und Raumforschung*, 57 (2-3), pp. 168–175. Rösch, A. 2000: Kreative Milieus als Faktoren der Regionalentwicklung. *Raumordnung und Raumplanung*, 58 (2-3), pp. 161–172.

⁷⁰ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122. Razpotnik Viskovič, N., Nared, J., Urbanc, M. 2008: Pogovor v kavarni: soočenje teorije in prakse. *Geografski vestnik*, 80 (1), pp. 119–126. Zumaglini, M., Nared, J., Alfarè, L., Razpotnik Viskovič, N., Urbanc, M. 2008: Participation process in regional development: DIAMONT's perspective. *Quaderni*, 52. Bolzano, Accademia Europea, 146 p. Razpotnik Viskovič, N.,

After the demise of mining, Idrija thus reoriented itself into industries that were based on technical expertise.⁷¹ This has ranked it among Slovenia's most developed towns, but the question is whether this reorientation might have a negative impact on Idrija's economic sustainability in the future. The companies enabled a very smooth transition⁷² to a market economy benefiting from a skilled work force adapted to an organized industrial work style; but, on the other hand, the success of such companies has silently tied employees to existing job opportunities and thus created hidden dependency. Idrija remained a traditional industrial society with a prevailing secondary sector attracting high-profile technical experts on the one hand, and unskilled and semiskilled workers from the wider region on the other. Although most people can find relatively secure jobs in the local community, work is not guaranteed for those educated in non-technical fields, who often move away from the region or commute daily to distant employment (or service) centers such as Ljubljana.⁷³

Furthermore, the security provided by such companies hinders the development of specialized high value-added services, such as business consultancy, financial and legal services, and services linked to extensive knowledge of mercury, as well as private initiatives and small-scale entrepreneurship. Due to the high level of employment, it is very difficult to obtain workers for services such as the catering industry, which operate on different principles with regard to their organizational scheme and work time. For them it was easiest to work for the mine and, in recent times, is still easiest to work for the two electrical appliance companies. Circumstances did not compel residents to create their own opportunities, but only to utilize the opportunities created by others.⁷⁴

Thus, with regard to economic sustainability, the main challenge Idrija is facing today is its monstructured economy and two other problems that could threaten the town's long-term development: lack of space for further development and poor accessibility (Figure 1).⁷⁵

4. NEW SUSTAINABLE OPPORTUNITIES

Industrial and technical capital are not the only advantages Idrija has to offer. In terms of sustainable opportunities, the competitive advantages of the area are rich in historical and technical heritage, a wealth of geological and geomorphological features, and a diverse and attractive landscape.⁷⁶ Its cultural heritage was internationally acknowledged in 2012, when »mercury heritage« (Figure 7) in Idrija was included on the UNESCO World Heritage List together with the Spanish town of Almadén. To acknowledge geoheritage, the »Idrija Geopark« was established in 2010,⁷⁷ and in 2013⁷⁸ it was accepted into the European Geoparks Network⁷⁹ and the Global Network of National Geoparks.⁸⁰ With these achievements, Idrija is

Urbanc, M., Nared, J. 2009: Prostorska in razvojna vprašanja Alp. Georitem, 12. Ljubljana, Založba ZRC, 94 p. Nared, J., Bole, D., Razpotnik Viskovič, N. 2014: Tradition and development: the case of Idrija, Slovenia. *Regions*, 293 (1), pp. 17–20.

⁷¹ Straus, M. 2010: O ustvarjalni kulturi mladih: za živahno prihodnost mesta. In: *Na prelomnici: razvojna vprašanja Občine Idrija*. Ljubljana, Založba ZRC, pp. 189–194.

⁷² Heritage of Mercury: Almadén and Idrija, 2011. URL: http://www.idrija.si/images/datoteke/strateski_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).

⁷³ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.

⁷⁴ *Ibid.*

⁷⁵ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.

⁷⁶ Kavaš, D., Koman, K. 2010: Razvoj in stanje gospodarstva v Občini Idrija. In: *Na prelomnici: razvojna vprašanja Občine Idrija*. Ljubljana, Založba ZRC, pp. 131–142.

⁷⁷ Geopark Idrija. URL: <http://www.geopark-idrija.si/si/geopark/75/kdo-smo/> (12. 12. 2014).

⁷⁸ Dragoš, Š. 2013: Svetovno priznanje ob domači neresnosti. *Primorske novice* (9. 9. 2013). URL: <http://www.primorske.si/Primorska/Goriska/Svetovno-priznanje-ob-domaci-neresnosti.aspx> (12. 12. 2014).

⁷⁹ European Geoparks Network. URL: <http://www.europeangeoparks.org/> (12. 12. 2014).

⁸⁰ Global Network of National Geoparks. URL: <http://www.globalgeopark.org/index.htm> (12. 12. 2014).



Figure 7: Anthony's Main Road («Antonijev rov») is the oldest part of the Idrija mine and is one of the oldest preserved entrances into any mine in the world; it was excavated only a decade after the initial discovery of mercury. Today this is the entrance to the Mine Museum (photo: Matija Zorn).

* Kavčič, M., Peljhan, M. 2010: Geological heritage as an integral part of natural heritage conservation through its sustainable use in the Idrija region (Slovenia). *Geoheritage*, 2, p. 150.

gaining many opportunities: a more comprehensive approach to protecting and using natural and cultural heritage, a place on the world map of tourist destinations with rich natural, cultural, and technical heritage, development of tourism and related activities (catering, hotels, and souvenir production and sales), and enhanced regional awareness.⁸¹ The economic potential of heritage can be reflected in increased tourism flows and resulting multiplier effects. In 1994, the oldest part of the mine was opened to the public. About 25,000 visitors visit each year, predominantly school groups (42%) and other groups (23%).⁸²

Technical heritage is mainly concentrated in the urban part of the municipality; that is, the town of Idrija and its nearby surroundings. However, the development of the rural hinterland and its close connection to the town should not be ignored. Some valuable activities for developing local cultural tourism products in rural areas, especially on the Črni Vrh Plateau in the southern part of the Municipality of Idrija, are already showing positive results and active participation of the locals in this process. This was carried out by introducing responsible tourism practices, which primarily emphasize the social aspect of tourism developed within the context of environmental sustainability.⁸³

5. CONCLUSION

Idrija is Slovenia's oldest mining town. The locals used to say: »The town is a mine, the mine is a town.« The town grew along with the development and expansion of the mine below ground. The buildings and streets (Figure 8) tell the stories about development, ups and downs, the people that lived and worked in the town over the centuries, their attitude towards the environment, culture, and more.⁸⁴ After five hundred years of intensive mining, the mine is now shut down and today only provides some main-

⁸¹ Nared, J., Erhartič, B., Razpotnik Viskovič, N. 2013: Including development topics in a cultural heritage management plan: Mercury heritage in Idrija. *Acta geographica Slovenica*, 53 (2), p. 401.

⁸² Kavčič, M., Peljhan, M. 2010: Geological heritage as an integral part of natural heritage conservation through its sustainable use in the Idrija region (Slovenia). *Geoheritage*, 2 (3), p. 150.

⁸³ Bole, D. 2014: Developing responsible tourism in the countryside using local culture and cultural heritage. In: *Managing Cultural Heritage Sites in Southeastern Europe*. Ljubljana, Založba ZRC, pp. 102–105.

⁸⁴ Gorjup-Kavčič, M., Režun, B., Eržen, U., Peljhan, M., Mulec, I. 2010: Natural, cultural and industrial heritage as a basis for sustainable regional development within the Geopark Idrija project (Slovenia). *Geographica Pannonica*, 14 (4), p. 139.

Figure 8: *Miners' houses and apartment blocks from the end of the nineteenth century are an important part of world heritage (photo: Bojan Erhartič).*



tenance and tourism functions. The town is prospering from its newly developed electrical industry and it is using the heritage of its mercury mine to develop cultural tourism.⁸⁵

Investment and restructuring activities in the 1970s and 1980s allowed Idrija's soft transition into one of Slovenia's most successful centers for electrical products, and the town is known for its high-tech firms.⁸⁶ Because of this, there was no economic and social crisis after the mine shut down.⁸⁷ Idrija's new industries are very much in line with modern economic trends. Idrija's industry is strongly export-oriented, innovative, and highly productive. The main problem is its monostructured economy, which is prone to significant risk because a recession could push the Municipality of Idrija into a critical situation. In addition, two aspects of natural conditions could also threaten the town's long-term development and economy: due to its location in the deep narrow Idrijca Valley, Idrija lacks suitable land for settlement and economic development, and it faces transportation difficulties because it is cut off from major transport axes (Figure 1).⁸⁸

Just as in the past, when it was generally held that the town was synonymous with the mine, a close mutual dependence between the town and local companies is evident today. Companies' economic success has been reflected in favorable social development because, despite Idrija's unfavorable natural conditions, its inhabitants remain in the region. Thanks to its industry, Idrija is an important employment center offering job opportunities to both local residents and people from neighboring areas.

However, it is the highly successful economic situation in particular that has created some negative side effects: high dependence on two major enterprises, a low level of self-employment, and a lack of entrepreneurship. The poorly represented service sector offers limited job opportunities for highly educated people from fields other than engineering. In the long run, this could lead to an unfavorable economic situation (especially if a crisis arises in this specialized area or if companies decide to move their facili-

⁸⁵ Zelenc, A. 2011b: Tehniška dediščina Rudnika živega srebra Idrija. *Geografski obzornik*, 58 (1), p. 12.

⁸⁶ Zumaglini, M., Nared, J., Alfarè, L., Razpotnik Viskovič, N., Urbanc, M. 2008: Participation process in regional development: DIAMONT's perspective. *Quaderni*, 52. Bolzano, Accademia Europea, 146 p.

⁸⁷ Gorjup-Kavčič, M., Režun, B., Eržen, U., Peljhan, M., Mulec, I. 2010: Natural, cultural and industrial heritage as a basis for sustainable regional development within the Geopark Idrija project (Slovenia). *Geographica Pannonica*, 14 (4), p. 139.

⁸⁸ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.

ties due to lack of available land for building new industrial structures or higher labor costs compared to some other countries).⁸⁹

Another problem is a lack of workforce. Both companies are focusing their efforts on improving their development centers, which is why they will need a great number of experts—who are, however, unavailable in this part of Slovenia (both companies' projections exceed the number of mechanical engineering students expected to graduate in Slovenia in the next ten years).⁹⁰

Importing experts from abroad seems like a possible solution but, despite its typical openness, Idrija is not in favor of this because it could threaten its identity and traditions.⁹¹ Despite all the changes Idrija's residents still believe that the town's profile continues to be based on the mining tradition and lace⁹².

Despite all of the open questions that Idrija is currently grappling with, one cannot ignore the fact that the closed mine and its five hundred years of history strongly shaped Idrija's residents and imprinted a number of characteristics into their minds that, even under altered economic conditions, ensure that Idrija continues to be integrated into global currents. This leads to the conclusion that historical experience is key to the performance of modern economic activities in Idrija, although there is no direct connection between current industry and mining. Idrija thus serves as an excellent example that confirms the role of »soft« development factors such as social and human capital, the image of the region, and quality of life. At least with regard to Idrija, these factors can fully substitute for the natural conditions (e.g., available construction land, natural resources, and energy) and location factors (e.g., infrastructure, good transport connections, and financial resources) that were considered key by traditional economic geography.⁹³

6. REFERENCES

1. Air Quality Guidelines for Europe, 2000. WHO Regional Publications, European Series, 91. Copenhagen, World Health Organization, p. 157. URL: http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (5. 3. 2015).
2. Batista, E. 2010: Idrijska čipka. DEDI - digitalna enciklopedija naravne in kulturne dediščine na Slovenskem. URL: <http://www.dedi.si/dediscina/46-idrijska-cipka> (20. 12. 2013).
3. Bole, D. 2014: Developing responsible tourism in the countryside using local culture and cultural heritage. In: *Managing Cultural Heritage Sites in Southeastern Europe*. Ljubljana, Založba ZRC, pp. 102–105.
4. Brate, T. 1985: Idrijske klavže. *Kulturni in naravni spomeniki Slovenije*, 136. Maribor, Obzorja, 22 p.
5. Čar, J. 1991: Klavže. In: *Enciklopedija Slovenije*, 5. Ljubljana, Mladinska knjiga, p. 90.
6. Čar, J., Dizdarevič, T. 2003: Pisna poročila o vplivu rudarjenja na naravno okolje v Idriji do konca 18. stoletja. *Idrijski razgledi*, 48 (1), pp. 14–25.
7. Castillo Martos, M., Lang, M. F. 1995: *Metales preciosos: Unión de dos mundos: Tecnología, comercio y política de la minería y metalurgia iberoamericana*. Sevilla, Muñoz Moya y Monraveta Editores, 224 p.
8. Dizdarevič, T., Čar, J. 2009: Zgodovinski opisi posledic pridobivanja in predelave živosrebrne rude na okolje v Idriji od 16. do prve polovice 20. stoletja. *Idrijski razgledi*, 54 (2), p. 45–55.
9. Dragoš, Š. 2013: Svetovno priznanje ob domači neresnosti. *Primorske novice* (9. 9. 2013). URL: <http://www.primorske.si/Primorska/Goriska/Svetovno-priznanje-ob-domaci-neresnosti.aspx> (12. 12. 2014).
10. European Geoparks Network. URL: <http://www.europeangeoparks.org/> (12. 12. 2014).
11. Fromhold-Eisbith, M. 1999: Das »kreative Milieu« - nur theoretisches Konzept oder Instrument der Regionalentwicklung? *Raumordnung und Raumforschung*, 57 (2-3), pp. 168–175.
12. Geopark Idrija. URL: <http://www.geopark-idrija.si/si/geopark/75/kdo-smo/> (12. 12. 2014).
13. Exposure to Mercury: A Major Public Health Concern, 2007. Zürich, World Health Organization. URL: <http://www.who.int/phe/news/Mercury-flyer.pdf> (5. 3. 2015).

⁸⁹ Ibid.

⁹⁰ Ibid.

⁹¹ Ibid.

⁹² Nared, J., Smrekar, A., Bole, D., Kozina, J., Fridl, J., Polajnar Horvat, K., Gabrovec, M., Repolusk, P., Zavodnik Lamovšek, A., Sever, B., Gantar, D., Kavaš, D., Koman, K., Rugelj, J., Makuc, K., Pellis, S. M. 2010: *Strokovne podlage za pripravo Inovativne strategije trajnostnega razvoja Občine Idrija*. Elaborat. Ljubljana, Geografski inštitut Antona Melika ZRC SAZU, 240 p.

⁹³ Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.

14. Gewerkenegg Castle – The Idrija Municipal Museum. URL: <http://www.muzej-idrija-cerkno.si/index.php/en/locationexhibitions/permanent-exhibitions/grad-gewerkenegg.html> (10. 12. 2014).
15. Global Network of National Geoparks. URL: <http://www.globalgeopark.org/index.htm> (12. 12. 2014).
16. Gorjup-Kavčič, M., Režun, B., Eržen, U., Peljhan, M., Mulec, I. 2010: Natural, cultural and industrial heritage as a basis for sustainable regional development within the Geopark Idrija project (Slovenia). *Geographica Pannonica*, 14 (4), pp. 138-146.
17. Gosar, M., Čar, J. 2006: Vpliv žgalnic živosrebrne rude iz 16. in 17. stoletja na razširjenost živega srebra v okolici Idrije. *Geologija*, 49 (1), pp. 91-101.
18. Gosar, M., Teršič, T. 2012: Environmental geochemistry studies in the area of Idrija mercury mine, Slovenia. *Environmental Geochemistry and Health*, 34 (1), pp. 27-41.
19. Hacquet, B. 1779: Beobachtungen und Heilungsmethoden einzelner Hornvierhkrankheiten, welche durch Gifte aus der drei Reichen der Natur verursacht werden. Sammlung nützlicher Unterrichte. Laybach, Joh. Friedrich Eger, Landschaftl. Buchdrucker.
20. Heritage of Mercury. Almadén and Idrija, 2011. Medmrežje: http://www.idrija.si/images/datoteke/strateški_dokumenti/MERCURY%20HERITAGE%20VOL%20I%20y%20II.pdf (20. 12. 2013).
21. Herlec, U., Poljanec, F., Rečnik, A., Režun, B. 2006: Rudišče živega srebra v Idriji. *Scopolia*, Suppl. 3, pp. 15–27.
22. Hidria razglašena za najinovativnejše podjetje v Evropi (7. 6. 2013). URL: <http://si.hidria.com/si/o-nas/novice-dogodki/7191/detail.html> (10. 12. 2014).
23. Hidria skozi zgodovino. URL: <http://si.hidria.com/si/o-nas/ozadje/> (10. 12. 2014).
24. Kavaš, D., Koman, K. 2010: Razvoj in stanje gospodarstva v Občini Idrija. In: Na prelomnici: razvojna vprašanja Občine Idrija. Ljubljana, Založba ZRC, pp. 131–142.
25. Kavčič, M., Peljhan, M. 2010: Geological heritage as an integral part of natural heritage conservation through its sustainable use in the Idrija region (Slovenia). *Geoheritage*, 2 (3), pp. 137-154.
26. Kladnik, D. 2010: Klavže na Idrijci. In: DEDI - digitalna enciklopedija naravne in kulturne dediščine na Slovenskem. URL: <http://www.dedi.si/dediscina/385-klavze-na-idrijci> (20. 12. 2013).
27. Kobal, A. B. 1995: Vplivi rudnika živega srebra na okolje in prebivalce v Idriji. *Idrijski razgledi*, 40, pp. 13-21.
28. Kobal, A. B. 2009: Pregled spoznanj o vplivu delovanja rudnika in živega srebra na zdravje prebivalcev v Idriji v preteklih stoletjih. *Idrijski razgledi*, 54 (2), pp. 21-34.
29. Kolektor 45 let. Informator, junij 2008. URL: <http://www.kolektor.com/resources/files/doc/komunitator/InformatorJunij08.pdf> (10. 12. 2014).
30. Košir, M. 2011: Beneška vojna – evropska vojna za vpliv v Italiji (1508–1516). *Idrijski razgledi*, 56 (1), pp. 26–55.
31. Leskovec, I., Peljhan, M. 2009: Idrija: Zgodba o petstoletnem srebrnem studencu. Idrija, Rudnik živega srebra, 86 p.
32. Mazi, S. 1955: Klavže nad Idrijo. Ljubljana, Tehniški muzej Slovenije, 70 p.
33. Mohorič, M. 2006: Vodni transport lesa in idrijski rudnik. *Idrijski razgledi*, 51 (1-2), pp. 80–81.
34. Nared, J., Smrekar, A., Bole, D., Kozina, J., Fridl, J., Polajnar Horvat, K., Gabrovec, M., Repolusk, P., Zavodnik Lamovšek, A., Sever, B., Gantar, D., Kavaš, D., Koman, K., Rugelj, J., Makuc, K., Pellis, S. M. 2010: Strokovne podlage za pripravo Inovativne strategije trajnostnega razvoja Občine Idrija. Elaborat. Ljubljana, Geografski inštitut Antona Melika ZRC SAZU, 240 p.
35. Nared, J., Bole, D., Razpotnik Viskovič, N. 2014: Tradition and development: the case of Idrija, Slovenia. *Regions*, 293 (1), pp. 17–20.
36. Nared, J., Erhartič, B., Razpotnik Viskovič, N. 2013: Including development topics in a cultural heritage management plan: Mercury heritage in Idrija. *Acta geographica Slovenica*, 53 (2), pp. 393-402.
37. Palinkaš, L. A., Pirc, S., Miko, S. F., Durn, G., Namjesnik, K., Kapelj, S. 1996: The Idrija mercury mine, Slovenia, a semi-millennium of continuous operation: an ecological impact. In: *Environmental Toxicology Assessment*. London, Taylor & Francis, pp. 317–341.
38. Paracelsus 1527: Von der Bergsucht und anderen Bergkrankheiten. Neuburg.
39. Pavlič, S. 1993: Idrijsko šolstvo skozi stoletja. In: *Idrijska obzorja: Pet stoletij rudnika in mesta. Idrija, Mestni muzej*, pp. 101–112.
40. Pavšič, J. (ed.) 2006: Geološki terminološki slovar. Ljubljana, Založba ZRC, p. 51.
41. Perger, H. 1873: Über die Schädlichkeit des idrianer Hüttenrauches. *Österreichische Zeitschrift für Berg- und Hüttenwesen*, 21.
42. Pfeifer, J. 1993: Zgodovinski razvoj medicine dela pri idrijskem rudniku. In: *Idrijska obzorja: Pet stoletij rudnika in mesta. Idrija, Mestni muzej*, pp. 93–100.
43. Pipan, P. 2012: Kamšt. In: DEDI - digitalna enciklopedija naravne in kulturne dediščine na Slovenskem, URL: <http://www.dedi.si/dediscina/462-kamst> (20. 12. 2013).

44. Razpotnik Visković, N., Nared, J., Urbanc, M. 2008: Pogovor v kavarni: soočenje teorije in prakse. *Geografski vestnik*, 80 (1), pp. 119–126.
45. Razpotnik Visković, N., Urbanc, M., Nared, J. 2009: Prostorska in razvojna vprašanja Alp. *Georitem*, 12. Ljubljana, Založba ZRC, 94 p.
46. Rösch, A. 2000: Kreative Milieus als Faktoren der Regionalentwicklung. *Raumordnung und Raumplanung*, 58 (2-3), pp. 161–172.
47. Rupnik, P. 2012: Že 50 let poganjamo prihodnost. *Informator*, december 2012, pp. 2–3. URL: http://www.kolektor.si/resources/files/doc/komunitator/informator_%20december12.pdf (10. 12. 2014).
48. Straus, M. 2010: O ustvarjalni kulturi mladih: za živahno prihodnost mesta. In: *Na prelomnici: razvojna vprašanja Občine Idrija*. Ljubljana, Založba ZRC, pp. 189–194.
49. Terpin Mlinar, M. 2010: Idrijska čipka. In: *Na prelomnici: razvojna vprašanja Občine Idrija*. Ljubljana, Založba ZRC, pp. 195–204.
50. Teršič, T., Biester, H., Gosar, M. 2014: Leaching of mercury from soils at extremely contaminated historical roasting sites (Idrija area, Slovenia). *Geoderma*, 226–227, pp. 213–222.
51. Urbanc, M., Nared, J., Bole, D. 2012: Idrija: A local player on the global market. In: *Locality, Memory, Reconstruction: The Cultural Challenges and Possibilities of Former Single-Industry Communities*. Newcastle upon Tyne, Cambridge Scholars Publishing, pp. 101–122.
52. Zelenc, A. 2000: Rudniške elektrarne. *Idrijski razgledi*, 45 (2), p. 69–77.
53. Zelenc, A. 2001a: In vendar se giblje: katalog obnovljenih rudniških strojev in naprav. *Idrija, Mestni muzej*, 79 p.
54. Zelenc, A. 2011b: Tehniška dediščina Rudnika živega srebra Idrija. *Geografski obzornik*, 58 (1), pp. 12–18.
55. Žibert, G., Gosar, M. 2005: Koliko živega srebra je akumulirano v poplavnih sedimentih reke Idrije? *Geologija*, 48 (1), pp. 97–105.
56. Zumaglino, M., Nared, J., Alfarè, L., Razpotnik Visković, N., Urbanc, M. 2008: Participation process in regional development: DIAMONT's perspective. *Quaderni*, 52. Bolzano, Accademia Europea, 146 p.
57. Zwitter, Ž. 2014: Okolje na Kranjskem v 17. stoletju po Slavi vojvodine Kranjske. In: *Studia Valvasoriana: zbornik spremnih študij ob prvem integralnem prevodu Die Ehre Deß Hertzogthums Crain v slovenski jezik*. Ljubljana, Zavod Dežela Kranjska, pp. 611–702.

SAŽETAK

Petsto godina rudarenja žive u gradu Idrija u zapadnoj Sloveniji rezultiralo je jako zagađenim i degradiranim okolišem. U posljednjih nekoliko desetljeća, a posebno od zatvaranja rudnika sredinom 1990-ih, grad je doživio donekle uspješnu tranziciju u druge, ekološki čistije industrije. Sam rudnik pretvoren je u muzej i zajedno sa širom regijom postao »geopark«, te mjesto svjetske baštine UNESCO.

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