THE ORNAMENTAL STONE INDUSTRY IN BRAZIL: ECONOMIC, TERRITORIAL, AND LABOR-RELATED CHARACTERISTICS

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PRESENTATION

The research report we now present was produced in the framework of a 2022 cooperation project bringing together BWI, FNV, and TruStone Initiative and allowed us a unique opportunity to deepen knowledge of the ornamental stone industry in Brazil.

The fact that natural stone companies are committed to complying with obligations set by international guidelines, e.g., the OECD Guidelines for Multinational Enterprises, the United Nations Guiding Principles on Business and Human Rights, and international labor standards, means that Brazilian labor organizations have an alternative path to defend working and living conditions not only for workers, but also for communities where industrial plants have been set up.

Traditionally, domestic and multinational companies operating in Brazil establish quite limited relations with union entities representing workers, when they do not simply adopt anti-union practices. Thereby, TruStone Initiative, by obliging companies to identify human rights risks in their supply chain, legitimizes a union action field from within the workplaces.

While conducting the research required to provide the answers this report enabled, including discrimination, child labor, forced labor, failure to pay minimum wage, the right to organize and bargain collectively, gender- and/or race-based discrimination, corruption, health and safety in the workplace, land rights, environment (including air, water, and soil pollution), we are faced with the restrictions companies impose on union action in Brazil.

Restrictions that came to impact the very development of this report as companies denied the researchers access to the premises, workplaces, and to the workers to verify the working conditions mentioned in interviews with government labor inspectors.

Restrictions that we expect to overcome in 2023, still within the TruStone Initiative framework, to carry on organizing sector workers through their unions. For that, the Building and Wood Worker's International (BWI) is grateful to the researchers, the initiative's partners, and the workers' unions in Brazil, calling on all to move forward to overcome said constraints and to attain more economic, social, and environmental sustainability in the sector.

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INTRODUCTION

The mineral industry holds a prominent place in the Brazilian economy because of the country's huge reserves and because it is the backbone of several industries' production chain. Stones serve various purposes in the construction industry depending on their geological characteristics and are used as raw material for aggregates, foundations, and as structural and finishing elements.

Stone resources can be broadly classified in two groups as nonmetallic granular minerals, which are used by the name of aggregates (e.g. sand, gravel, limestone, gypsum, cement, etc.), and those minerals used as blocks or slabs, termed ornamental stones. The stones in the latter group will be the focus of this report.

Given their importance and widespread use worldwide in the construction industry, ornamental stones are highly valued in the global market; yet they should not be understood as commodities, but rather as specialties, given their distinctive features across exemplars of the same species, just as with hardwoods – with unique compositions in terms of designs, textures, chromatic patterns, etc. Therefore, they lack the standardization that is characteristic of commodities, which, by definition, are undifferentiated, as well as pricing on international mercantile exchanges.

Given the enormous variety of ornamental stones, the criteria for naming each of them are diffuse, invariably with the recurrence of stones from different families carrying the same name and stones from a same lineage receiving different names. (Frascá, 2014) At any rate, the specialized literature classifies them in three major groupings: silicate minerals, carbonate rocks, and siliceous rocks (Abirochas, 2018), which will be further discussed in the first section of the report. Despite their diversity, ornamental stones are marketed in blocks or slabs. The first form has low added value for there is little processing, while the latter requires technology and treatment that increase the product's final price.

As for the general applications of ornamental stones in the business industry on a global scale, their use, in order of importance, is in floorings, tops and countertops, wall and façade tiling, and to a smaller scale in building structures. Another important sector of ornamental stone application, though much less relevant when compared with the construction sector, is that of funerary art and artistic objects, of lesser importance in Brazil, which is the only relevant producer of Latin America.

The ornamental stone business in Brazil amounted to US$1.3 billion in exports and 3.3 million tons in 2021, including stone blocks and slabs. The USA is Brazil's largest importer, followed by China. Brazil is the fifth largest exporter and producer of ornamental stones in the world, and is the industry's only relevant actor in Latin America.

Brazilian production is mostly targeted to the domestic market: 67.6% of the production remained in the country, which in 2021 consumed 6.9 million tons, while exports amounted to 3.3 million tons. These figures serve as an indicator of the country's construction industry performance, which remains as the flagship of the production chain demand.

1. Ornamental stone typology, concepts, and definitions

Stones are natural solids formed by aggregation of one or more crystalline minerals. Geologically, they can be classified in three broad generic groups: igneous, sedimentary, and metamorphic rocks (Abirochas, 2019). Igneous rocks, also called magmatic rocks, are the result of the solidification of magma on the Earth's crust. Sedimentary rocks, as implied by the name, result from the sedimentation of preexisting detritus and mineral particles, formed both in water and land environments. Metamorphic rocks also result from the transformation (metamorphism) of preexisting rocks under increased pressure or temperature.

Ornamental stones can also be referred to as natural stones, dimensional rocks, or masonry material, and can be extracted in blocks or slabs, with various shapes and cuts. Ornamental stone processing includes polishing, burnishing, squaring (right-angle cutting), or shaping to be used as a finished good, as occurs with slate tiles, sinks etc.

Color (chromatism) and structural (arrangements of crystals, hardness, translucency, etc.) patterns are the main attributes when classifying stones commercially, which can also be classic, ordinary, or exceptional ones. Classic stones are those whose commercial appeal is not altered by momentary esthetic trends, comprising mostly red, white, yellow, and black marbles, in addition to white, green, black, and red granites. Ordinary stones, also referred to as "*de batalha*" [freely all-purpose], for their widespread use in the construction industry for coating purposes, include beige and greyish marbles, besides rosy, brownish, and greyish granites. Exceptional stones are commonly used in small scale in artistic pieces and for coating high standard objects, while also being termed exotic for their chromatic, structural, and textural patterns, comprising violet, green, and blue marbles, as well as yellow, blue, multicolored, and pegmatitic (feldspar with interlocked quartz) granites.

Ornamental stones are known by their lithology, i.e., their description on the basis of color, mineral composition, and granulation. There are three big lithologic groups: silicate, carbonate, and siliceous rocks, all of which are used mostly in civil construction.

Silicate rocks are formed by silicate minerals such as feldspar, mica, and amphibole, and occasionally interlocked with siliceous minerals, like quartz. Commercially, they are identified as granite, pegmatite (feldspar), and schist.

Carbonate rocks are those primarily formed by calcite, dolomite, magnesite, and other carbonates, and silicate and/or siliceous minerals. In this group are what is commercially known as alabaster, marble, travertine, limestone, and onyx (onyx marble).

Lastly, silicate rocks are essentially formed by quartz or amorphous silica, with the occurrence of carbonate or siliceous minerals. Commercially they include materials classified as quartz, quartzite, and metaconglomerate.

2. Domestic and foreign markets and main producing regions

Article 176 of the Federal Constitution establishes that deposits, whether mined or not, and all other mineral resources and hydraulic energy potentials belong to the Union. Exploitation of mineral resources requires a concession which is regulated by a body of federal laws of a broader nature and by more specific state and municipal laws. Regulation, concession, and oversight of the mineral sector is incumbent upon The National Mining Agency (ANM, from the Portuguese acronym), a federal autarchy, i.e., independent regulatory agency, created by Law 13,575/2017.

> "According to data by IBRAM, based on preliminary data in the 2017 Annual Mining Report, consolidated by the National Mining Agency (ANM), in that year there were 9,530 mines in Brazil, 135 of which are large mines (1.4%), 992 medium-sized mines (10.4%), and 2,750 small mines (28.9%). Besides these, there also were 5,653 micro-sized mining undertakings, accounting for 59.3% of total mines, while Minas Gerais [is] the state with the largest number of active mines (3,339)." (BRASIL, 2019, p. 23)

Brazil has a rich geological diversity and is **the world's fifth largest producer of ornamental stones (5.3% of global production in 2019), with an estimated production of 10.2 million tons in 2021. The country is the world's sixth largest exporter, with 3.3 million tons (MT) exported in 2021.** In 2019, the latest year with estimates for all other countries, **Brazil's share was 3.7% of global exports in terms of volume, and 5.1% of global revenues in U.S. dollars**. (Abirochas, 2021) It is the only relevant country in Latin America to take part in this industry. **China, which used to lead global exports (it held 22% of total exports in 2016 and fell to 17.2% in 2019), was outranked by India, which leads exports with 23.1% of total exports**. Turkey (12.9%), Italy (4.5%), and Portugal (3.9%) precede Brazil in this ranking.

Brazilian exports in 2021 amounted to US$1.34 billion, with 2.4 million tons exported, an increase of 35.5% in revenue and 11.4% in physical volume in comparison with 2020. (Abirochas, 2022) This was the Brazilian industry's record at the time, exceeding the 2013 peak (US$1.30 billion and exhibiting a 22.8% growth in relation to 2012). Marble slabs, quartzites, and soapstone increased their share in exports, as they are higher value added products, simultaneously with a shift

in global demand preference, particularly in the United States, which has been prioritizing porcelain slabs and artificial rock materials, trends reflected by Brazilian export figures.

Despite that year's significant currency devaluation, the average price per ton exported rose 21.6%, from US$ 457.60/t in 2020 to US$ 556.50/t in 2021, prompted both by more robust international demand, particularly from the U.S., and by a greater share of higher value added products in Brazil's exports.

The USA accounted for US$838.60 million and 996.3 thousand tons of Brazilian exports, while China accounted for US$153.7 million and 713.9 thousand tons. Although trade with the U.S. is 5.5 times bigger than with China, in terms of export volumes this gap is just 1.4 times bigger. That is so because the U.S. market demand is oriented to higher added value stones, while China imports raw materials that are value added by Chinese companies and then exported, a behavior much like that observed in relation to Italian companies. China is the world's top importer of ornamental stones, with 13.6 MT (24.3% of total import volume), followed by the USA (4.1 MT and 7.3%), South Korea (3.0 MT and 5.4%), and Germany (1.9 MT and 3.4%).

The average price of products exported to the USA, mostly slab processed stones, was US$ 840/t, as contrasted with an average price of US$ 220/t for the products exported to China, which only imports stones in blocks. Only Taiwan's average price, at US$ 190/t, was lower than China's.

Espírito Santo state, followed by Minas Gerais and Ceará states, are the top Brazilian states in terms of ornamental stone exports. With, respectively, US$ 1.10 billion and US$ 132.8 million, Espírito Santo and Minas Gerais account for 93.2% of Brazil's total export revenues. Together, Ceará, Bahia, Rio Grande do Norte, and Pernambuco states account for 5.5% of export revenues. An increasingly more significant share of Espírito Santo state exports of processed stones is derived from stones mined in other states, especially in Bahia and Minas Gerais.

Studies conducted by Instituto Metas (2002) showed the existence of 18 ornamental stone and coating production clusters in Brazil, with mining activities being performed in 10 Brazilian states and 80 municipalities. More broadly, 370 municipalities received royalties in the form of Financial Compensation for the Exploration of Mineral Resources (CFEM, in the Portuguese acronym) derived from the exploration of ornamental stones.

No new production cluster appeared after 2002, with a scaling up of mining of pegmatites, exotic granites, and quartzites in northern Minas Gerais state, as well as pegmatites, marbles, and mostly, solid quartzites in Bahia. Brazil's northeastern region, particularly the states of Ceará and Rio Grande do Norte, has become exceptionally promising for exotic rocks, solid limestone, and marbles. States in northern Brazil, fully or partially within the so-called Legal Amazonia region, are Brazil's latest frontiers for ornamental stone production and processing. These regions' less stringent compliance

standards (reduced enforcement and regulatory capacity by local and even federal authorities) have attracted mining companies threatened by more stringent standards and increased enforcement in mines situated in more traditional regions (like Espírito Santo and Minas Gerais).

In mining terms, demand for artificial rock materials and porcelain slabs, which perfectly reproduce rocky elements, is a growing trend in the international market, which will ultimately require a Brazilian repositioning regarding its mining industry's processed products. Experts agree that blocks and slabs, despite a sharp rise during the pandemic period, are likely to steadily lose their importance in the international market. Specializing in artificial aggregates is bound to be the next frontier in terms of market expansion, also because of the environmental concerns the industry raises.

In spite of Brazil's significant financial results derived from its exports, the country's main ornamental stone market is still domestic. Brazil consumes good part of its production, 67.6% in 2021, or 6.9 million tons, against 3.3 million tons that are exported (32.4% of total production). The main purchasing state is São Paulo, which consumes 45% of the country's sales. The states of Rio de Janeiro (RJ), Espírito Santo (ES), and Minas Gerais (MG) account for 22%, while the Southern macro region accounts for 14% of home purchases. The Northern, Northeastern, and Mid-Western macro regions total 19% of domestic market consumption.[3] (Abirochas, 2022)

Brazil's most explored rock is granite and similar products, which accounted for 45.7% of total production, or 4.2 million tons in 2021. Next come marble and travertine, accounting for 25% of the production, or 2.3 million tons. Solid quartzite accounts for 16.3% of the production, or 1.5 million tons, while limestone, foliated quartzite, Miracema gneiss, and other rocks (basalt, Cariri stone, soapstone, etc.) account for 13% of the production and amount to 1.2 million tons.

Espírito Santo state has specialized in the production of granite and marble, extracting 3 million tons of these rocks in 2021, which accounted for about 30% of national production (3 MT). Minas Gerais boasts the largest product diversity, extracting granite, pegmatite, slate, quartzite, foliated quartzite, solid quartzite, soapstone, talc, serpentine, marble, and basalt, that amount to 2 million tons, or 19.6% of the country's production. The third largest state in terms of volume is Bahia, which mined 1.6 million tons of granite, pegmatite, marble, travertine, sandstone, and solid quartzite, accounting for 15.7% of Brazilian total production. Ceará extracted 1.2 million tons of granite, pegmatite, limestones, and Cariri stone (plated limestone), with an 11.7% share in Brazilian production. Paraíba state mined 500,000 tons of granite and conglomerate rock, contributing with 5% of the country's production. These four states accounted for 82% of the production in 2021.

The most consumed rocks in the domestic market are granite (45.5%), marble and travertine (33%), slate (6.5%), foliated and nonfoliated quartzites (6.5%). Granite –in blocks or slabs– leads exports,

[3] 2019 data.

hitting US$475.3 million in 2021. Ashlar or construction stones not specified in the Mercosur Common Nomenclature (NCM), which categorizes import and export goods internationally, account for US$353.1 million. A difficulty of identifying ornamental stones is the absence of specific classifications in the NCM codes, which prevents a better understanding of goods exported and the importing countries' preferences.

3. Companies and labor market in Brazil

According to data by the Brazilian Association of Dimension Stones Industry (Abirochas), the ornamental stone production chain in Brazil employed approximately 120,000 direct and 360,000 indirect workers in 2020, bringing together around 10,000 companies and at least 400 exporters on a regular basis. (Abirochas, 2018) The mining business, including services and sales of machinery, equipment, and inputs, amounted to approximately US$5 billion that same year. Some 6,000 companies, or 60% of the industry's production chain, are marble factories, mostly micro and small companies, which also account for most of the industry's jobs.

The installed capacity for cutting and polishing rocks quarried in blocks in Brazil is of 90 million square meters a year,[4] with most of the looms for sawing slabs installed in Espírito Santo state, which concentrated 78% of the country's sawing capacity in 2020. This processing of rocks, that are shaped into slabs, accounts for most of the so-called "special processing products", and it is estimated that by 2025 processing capacity will reach 100 million square meters a year in Brazil. We also have "simple processing products", obtained from rocks formed by natural splitting, such as slates, quartzites, plated basalts, etc. The installed processing capacity of these products is 50 million square meters a year.

The state of Espírito Santo concentrates the largest number of clusters, or local productive arrangements (APLs, in the Portuguese acronym), concentrating on rock mining and processing and specializing in marbles and granites. Minas Gerais concentrates APLs focusing on slates and foliated quartzites; Rio de Janeiro, on foliated gneiss; Rio Grande do Sul, on plated basalts; Bahia, on travertines; and Ceará, on plated limestones. The country's southeastern states, São Paulo in particular, which concentrates the largest demand for ornamental stones for its construction industry, hosts 70% of the country's marble factories, in addition to specialized finishing activities and sophisticated design services.

In 2020 the number of marble factories in Brazil was estimated at 6,000 companies (60% of the industry's companies), 2,000 processing companies (20%), 1,000 mining companies (10%), 400

[4] For 2-centimeter-thick slabs.

export companies (4%), 300 services firms (3%), 100 slab deposits (1%), and 100 companies producing machines, equipment, and inputs (1%).

Marble factories are the industry's top employer: some 60,000 factory workers, or 50% of the industry's total jobs. About 30,000 workers occupy positions in the processing industry (25%); 20,000 in quarries and mines (17%); 4,000 in the education and services areas (3.5%); 2,000 in export companies (1.5%); 2,000 in the machinery, equipment, and inputs industry (2%); and 1,600 in slab warehouses (1.0%). (ABIROCHAS, 2021)

The data above can be found in internal surveys conducted by Abirochas, the association that brings together data provided by industry companies to generate statistics designed to support the employers' association's strategies. Surely these figures include informal employment and companies struggling to offer employment contracts, especially marble factories, figures most often lacking in the country's official databases.

Yet upon reading the Annual Social Information Report (Rais), which brings data on formal employment in regular companies in Brazil, some discrepancies arise. Consideration must be given to the fact that the National Classification of Economic Activity (CNAE, from the Portuguese acronym), which classifies the activities used in the Rais, has some limitations. There is, for instance, no classification code for companies importing or exporting any kind of goods. The distinction between activities associated with artificial aggregates and those associated with ornamental stones is unclear,[5] the same with regard to activities associated with the manufacturing of nonmetallic mineral mining machines and equipment analyzed herein.[6] Nonetheless, for this report we selected CNAE 2.2 subclasses for ornamental stone-related activities, including mining, processing,[7] and machinery.

In 2019, there were 2,707 companies in Brazil associated with ornamental stone mining activities, which reported 51,000 formal jobs – an average of 18.8 formal jobs per establishment. Of these, 146 operating companies reported having no employment contracts, which probably means that those employed by them were individuals working as companies with their own employer identification number CNPJ. The industry's top employer had 792 regularly hired workers on 31 December 2019

[5] For mining-related activities codes used were those of CNAE 2.2 subclasses: 0810001 - Slate mining and associated processing; 0810002 - Granite mining and associated processing; 0810003 - Marble mining and associated processing; 0810004 - Limestone and dolomite mining and associated processing; 0810009 - Basalt mining and associated processing; 0810099 - Stone and other materials quarrying and crushing for construction and associated processing; 0899199 - Mining of other nonmetallic minerals not previously specified; 0990403 - Nonmetallic mineral mining support activities.
[6] Code used: 2852600 – Manufacturing of other mineral mining machines and equipment, parts and accessories, except oil extraction.
[7] For ornamental stone processing activities, the codes used were: 2391501 – Non-mining-related stone crushing; 2391502 – Non-mining-related stone processing for construction industry; 2391503 – Marble, granite, slate, and other stones slab processing and related activities.

and 12 business units across the country operating in the stone mining industry. The next two largest companies employed, respectively, 749 and 705 workers.

In 2019 the ornamental stone industry had 45,251 formal jobs, distributed across 5,982 companies, an average of 7.5 jobs per establishment, thus rendering the profile of the small marble factory owners quite clear. In the three biggest factories the number or workers was 522, 306, and 243 employees, including headquarters and branches.

In the mineral mining machinery, equipment, and inputs industry (except oil extraction), there were 5,115 formal jobs in 2019, distributed across 135 companies, an average of 38 jobs per company – which shows the greater effect of capital concentration in the capital goods industry. The three largest companies had, respectively, 526 employees and two business units; 522 employees and 4 business units; and 427 employees and only one business unit (headquarters).

Overall and despite the Rais report limitations, the ornamental stone industry had, in 2019, 101,399 formal jobs in 8,824 businesses. In 2018 these figures were quite similar in terms of number of jobs, with 101,342 formal jobs, even though the number of companies leaped to 10,000.

4. Overview of working and health conditions in the mining industry

In order to provide an overview of the working conditions in the mining industry, interviews were conducted with Ministry of Labor medical doctor and tax auditor Mário Parreiras de Faria, from the Minas Gerais state superintendency, and with mechanical and health and safety engineer Marta de Freitas, in addition to a review of the academic literature on the mining industry.

The exploration and processing of mineral resources result in significant impact on the environment and health such as air pollution and the emissions of particles harmful to health, modification of topography, suppression of vegetation, the silting up and contamination of rivers, soil contamination by heavy metals that accumulate in living organisms, death of animals, respiratory and degenerative diseases, in addition to accidents of great magnitude that claim thousands of lives, like the collapse of dams.

Extractive mining is the world's industry with the highest number of, notoriously serious and fatal, work accidents. "In Brazil, the work-related mortality rate in the mining sector ranged from 58.7 and 126.38 from 1999 to 2019, while the national fatal work injury rate, for all economic sectors, varied between 20.03 and 5.59 over the same period." (BRASIL:2019) What we can conclude from this data is that the risk of dying is high in every production sector (mortality rate of 5.59) and even much higher in the mining industry (mortality rate of 126.38) in 2019.

The mining industry is also responsible for a great number of retirements for invalidity caused by serious accidents that disable workers at working age, prematurely removing them from the labor market. According to the table below, the injury, death, and disability rates are quite high in the 16–34 age range in mining companies, mostly in the sectors highlighted, which are the focus of this study.

INDICADORES DE ACIDENTE DE TRABALHO NA MINERAÇÃO - PREVIDÊNCIA SOCIAL 2020							
Classes do CNAE	**Incidência**	**IncDoença**	**IncAcTrab**	**IncIncap**	**TxMortal**	**TxLetal**	**TxAc16a34**
0500:Extração de Carvão Mineral	39,02	0,00	31,47	33,99	0,00	0,00	47,58
0600:Extração de Petróleo e Gás Natural	14,16	0,52	12,30	3,45	0,00	0,00	25,30
0710:Extração de Minério de Ferro	9,27	0,34	7,82	4,21	5,64	6,09	43,81
0721:Extração de Minério de Alumínio	8,35	0,00	6,73	3,25	0,00	0,00	38,89
0722:Extração de Minério de Estanho	15,71	0,68	14,34	7,51	0,00	0,00	34,78
0723:Extração de Minério de Manganês	11,55	0,00	9,12	4,86	0,00	0,00	52,63
0724:Extração de Minério de Metais Preciosos	14,63	0,18	12,23	7,62	6,00	4,10	52,46
0725:Extração de Minerais Radioativos	15,87	0,00	11,33	6,80	0,00	0,00	14,29
0729:Extração de Minerais Metálicos Não-Ferrosos não Especificados Anteriormente	**11,32**	**0,17**	**9,40**	**3,25**	**24,97**	**22,06**	**43,38**
0810:Extração de Pedra, Areia e Argila	**19,20**	**0,20**	**16,34**	**17,47**	**33,62**	**17,51**	**37,13**
0891:Extração de Minerais para Fab. Adubos, Fertilizantes e Outros Prod.Químicos	16,59	0,00	14,74	13,08	18,43	11,11	44,44
0892:Extração e Refino de Sal Marinho e Sal-Gema	23,04	0,00	19,20	20,10	0,00	0,00	49,02
0893:Extração de Gemas (Pedras Preciosas e Semipreciosas)	21,73	0,00	20,82	18,11	0,00	0,00	33,33
0899:Extração de Minerais Não-Metálicos não Especificados Anteriormente	**17,19**	**0,48**	**14,21**	**14,33**	**35,82**	**20,83**	**37,50**
0910:Atividades de Apoio à Extração de Petróleo e Gás Natural	14,33	1,10	11,87	3,83	0,00	0,00	35,03
0990:Atividades de Apoio à Extração de Minerais, Exceto Petróleo e Gás Natural	**12,06**	**0,00**	**8,32**	**10,81**	**41,58**	**34,48**	**55,17**
Fonte: Previdência Social							

An analysis conducted by the Labor Inspection Secretariat (SIT, from the Portuguese acronym) shows that, in 2019, 36% of accidents and sicknesses affected the fingers and 14.5% affected multiple parts of the body. As to the nature of the injuries, main injuries were cuts/lacerations, fractures, contusions/crushes, and sprains/strains.

Considering that the official data on work injuries are underestimated, reality in the mining industry is bound to be even more serious and painful, as the working process is heavy in itself, involving a range of activities such as moving, drilling, and imploding rocks, the processing, treatment, and storage of minerals and their waste, and other operations that pose risks and suffering.

The typification of risks is complex, for it depends not only on the mineral being mined, but also on its geological formation and the host rock, which might contain other contaminant minerals, asbestos for instance, as well as on whether mining is open-pit or underground, and also on the mining method. (BRASIL, 2021).

The seriousness of typical accidents is generally related to the stability of the rock massif, i.e., collapses, and to inadequate machine and equipment protection and signage, and to other safety conditions neglected by companies, as we shall address ahead.

Met opmerkingen [R1]: INDICADORES DE ACIDENTE DE TRABAHO NA MINERAÇÃO – PREVIDÊNCIA SOCIAL 2020 = MINING WORK ACCIDENTS INDICATORS – SOCIAL SECURITY 2020

Classes do CNAE = CNAE classes

Incidência = Incidence

Inc Doença = Disease incidence

IncAcTrab =Work accident incidence

IncIncap = Invalidity incidence

TxMortal = Mortality rate

TxLetal = Lethality rate

TxAc16a34 = Accident rate for 16-34 age range

0729: Extração de Minerais Metálicos Não-Ferrosos não Especificados Anteriormente = Extraction of non-ferrous metal minerals not previously specified

0810: Extração de pedra, argila e areia = Extraction of rocks, clay, and sand

0899: Extração de Minerais Não-Metálicos não Especificados anteriormente = Extraction of Non-Metallic Minerals not previously specified

0990: Atividades de Apoio à Extração de Minerais, Exceto Petróleo e Gás Natural = Activities supporting mineral extraction, except oil and gas

Fonte: Previdência Social = Source: Social Security

5. Other occupational hazards and profile of morbimortality

The production of ornamental stones involves multiple occupational hazards in all of its stages, from extraction through the processing and transportation, which confers on the industry maximum risk grade in the health-and-safety-at-work legislation, as it is widely known to be unhealthy, arduous, and dangerous, while it can also be extremely exhausting for the workforce.

Exhausting is understood in this study as the negative transformations prompted by the dynamic integration of workloads, that is, physical, biological, mechanical, ergonomic risks, etc., that acquire internal materiality by interacting in the workers' bodies, leading to workers developing a disease or losing actual and/or potential work capacity, which may or may not manifest itself as what the medical science recognizes as a work-related disease. (LAURELL, 1989)

As far as human energy is concerned, every job can be exhausting; however, in some industries exhaustion is accentuated by conditions that affect the physical or mental integrity of workers, that is, people age and die before most of the rest of the population. Actually, this is one of the premises for early retirement, to which some professional groups are entitled.

In mining it is estimated that the maximum length of time workers will have the physical strength to perform the job is 15 years, as they are exposed to vibrations, unbearable noise, heat, dusts, handling of heavy equipment, dampness, and so forth. In the marble and granite industry, activities are performed in the open, often in high places, and the equipment is complex and heavy. Hearing impairment, musculoskeletal disorders, and respiratory and neurological diseases are pointed out by the literature as significant in the mining industry, besides the more typical accidents, often serious and fatal, caused by multiple situations as the ones mentioned earlier and others such as cables breaking while blocks are being moved, lack of signage during equipment transportation, among other issues. (TRIGINELI, 2011)

A serious risk is exposure to crystalline silica, which is a chemical agent present in ornamental stones and found in higher levels in sandstones, quartzites, granites, and slates, that is associated with silicosis, lung cancer, tuberculosis, and autoimmune diseases. Marbles contain the lowest level of crystalline silica, whereas products like Silestone, a product made from natural quartz and other composites, can contain a concentration of crystalline silica of up to 95%. (FUNDACENTRO, 2008)

> "Silicosis is an incurable pulmonary disease caused by accumulation of dust containing crystalline silica in the alveola. This extremely fine and invisible dust attacks pulmonary tissues, damaging them and making it harder to breathe. The development of silicosis will depend on the amount of dust containing silica that is present in the workplace and the length of time a worker is exposed to it. At its early stage most workers do not feel anything, yet if exposure to dust continues, symptoms

> like cough, weight loss, and shortness of breath after performing certain activities can quickly develop." (FUNDACENTRO, 2008, p.11)

Both those workers directly involved in the activities of cutting, sawing, polishing, and so forth and those performing support, maintenance, and cleaning activities are exposed to dust, which requires collective and individual protective measures, training, as well as systematic monitoring of the workers' health conditions through medical, laboratory, and image tests.

Humidifying operations that generate dust, installing local exhaust ventilation systems, isolating or sealing dust-generating sources, and setting in place a maintenance program are among the main collective protection measures, coupled with individual protection measures such as mask-wearing.

According to health care specialists, the origin of silicosis is predominantly occupational, yet in open-pit mining activities there is also the risk of contaminating the surrounding population.

Workers exposed to silica are 2.1 times more likely to develop lung cancer, likelihood that is increased to 2.8 times for workers with silicosis. Pulmonary tuberculosis risk among silicotic workers is 40 times higher than that of the population in general, besides other pulmonary problems this population is more susceptible to acquire, and autoimmune diseases such as rheumatoid arthritis, systemic lupus erythematosus, and kidney problems. (BRASIL, UERJ: 2010)

A map of silica exposure in Brazil prepared by the Ministry of Health in 2010, showed that in 2007 the number of workers potentially exposed to silica was approximately 6 million people. Mineral extraction and civil construction are the sectors with the highest number of exposed workers, respectively 62.45% and 52.85% (BRASIL, UERJ: 2010)

Despite the seriousness of this public health problem, data on the reality of these and other industries are still quite precarious. Still according to the aforementioned study, under-reporting of diseases caused by silica can be as high as 97%, while in some states under-reporting is complete:

> "Even if we take the most conservative estimate based on calculations of the annual incidence of silicosis derived from social security data, of 20 new silicosis cases a year per 100,000 people exposed, the notification time series of silicosis cases between 2006 and 2009 presents us with an under-reporting of at least 97%, while in a majority of states under-reporting is complete. In figures, of the 2,400 new silicosis cases estimated for the period, less than 200 were reported! Tackling this weakness in the short term is imperative to provide [national health system] SUS with stronger governance over the future steps to be taken." (BRASIL, UERJ:2010, p 14)

As part of the strategies to bridge this gap, the Ministry of Health has made silicosis a compulsory reporting disease and has prepared manuals for primary health-care workers with guidance on surveillance and health care. Still, a nexus between developing a disease and work is not always established, even in territories that are home to productive activities that generate silica dust. Minas Gerais state leads the number of case reports, even though still far from capturing the workers' reality and identifying companies neglecting working conditions.

Concluding this overview, the mining industry faces other significant risks including noise, caused by heavy crushing, grinding, and perforating machines; exposure to cold, heat, humidity; vibrations from operating big equipment and hand tools such as sledgehammers and sanding machines; metallic fumes by welding and cutting activities; engine exhaust fumes; exposure to fungi, bacteria, and other parasites as a result of precarious hygiene conditions; excessive physical effort, lifting and carrying weights, inadequate postures, and risks related to the organization of work, i.e., inflexible productivity controls, shift work, and the excessive pace of work can all be found in mining work. (BRASIL:2019)

6. Intervention limits and potential

Far from being chance disasters, work accidents and occupational diseases are the result of technical and organizational choices that define human activity in productive systems in different historical contexts, and therefore are determined by social conditions, and are predictable and avoidable. High mortality, disability, and sickness rates brought about by work done in mines and other industries are the most striking expression of the asymmetries of power in labor relations and of many employers' utter disregard for human life.

Despite the gravity of the situation, this is a problem with little social visibility on account of several factors including the entrenched view that naturalizes accidents as resulting from technological development and from the human failure notion, which blames the workers, covering up the employers' responsibilities in face of weak institutional and political mechanisms that may guarantee the quality of working conditions.

So, the organized action of workers in denouncing and making demands, as well as government enforcement by means of health and labor oversight and inspection mechanisms, is relatively weak, regardless of the robust legislation Brazil has in place for the protection of safety and health at work, which includes a regulatory technical standard specific for mining and the Mining Code itself, which also sets safety and health at work standards.

One of the gaps, as mentioned, was an insufficiency of information on the reality of work, since official statistics on work accidents only considered formal workers protected by social security while leaving out thousands of casual, informal workers, in addition to the fact that work is not considered

in the public health-care system's diagnostic hypotheses, which makes it difficult to investigate diseases and to adopt health-related prevention programs and surveillance, and ultimately for the government to intervene in risk situations.

The Notification of Work Accident (CAT, in Portuguese), which, theoretically should be the most important reporting mechanism, is not always issued, especially in cases of occupational diseases, while it is mostly focused on social protection issues, social protection benefits, rather than on epidemiological issues. Even though reliance on CAT has been reduced with the adoption of the epidemiological technical nexus by the social security, which compares prevalence of diseases with the National Classification of Economic Activity (CNAE, from the Portuguese acronym), among medical experts still prevails a logic of protecting the companies by not acknowledging diseases caused by work.

It is also worth noting that, in the case of mining, the activity code, or CNAE, of the company where a given accident has occurred does not allow identification of the type of mining, if underground or open-pit, while several companies operating in mining have a CNAE that is different from typical mining codes, (BRASIL:2019) a problem that is probably related to the transferring of the right to explore a mine to a third party, a mechanism that according to studies is widely used in the mining industry; in other words, a permit is issued by the National Department of Mineral Production to a particular company while exploration is actually conducted by another company, not to mention illegal companies, with poor capabilities and technological standards, that violate health-related and environmental protection standards. (TRIGINELI, 2011)

According to the study above, a common practice is that trustworthy employees of a given company research for areas with potential for exploration and register the most advantageous ones in their own names and then negotiate exploration with big companies, as well companies that transfer machinery to employees who conduct themselves the exploration without any technical expertise. (TRIGINELI, 2011)

Oversight both of the mines being explored and of labor relations is poor, and conducted by an insufficient number of inspectors.

Of critical importance in the fight against slave labor, child labor, and noncompliance with health and safety at work standards, labor inspection in Brazil is at a 20-year low. According to information by the labor inspectors' national union, today there are 2,000 active inspectors, while the staff needed should be four times bigger. (SINAIT:2021)

"According to data by [federal labor inspection system] SFIT, from January 2017 through September 2020, 255,879 inspections were held focusing on safety and health at work all over the country, 2,947 of which were in companies with a mining industry CNAE activity code. Thus, we find that

inspections in the mining sector accounted for 1.15% of total inspections" (BRASIL: 2021), an extremely low index in a sector widely regarded as dangerous.

As mentioned, the mining industry is regulated by a specific technical standard on health and safety risk management, Regulatory Norm 22, which coupled with the other labor protection mechanisms, has since 2018 been going through a deconstruction process, under the argument that it is necessary to simplify and reduce labor protection standards.

Although NR 22 is still in effect, noncompliance with this standard was reported in 70% of the inspections conducted between 2017 and 2020; 74 companies had their operations suspended for posing imminent and serious risks to workers' health and safety. Risk management programs are either lacking or inadequate in many companies, thus exposing workers to risks and threats, without adequate protection or prevention measures. The situation is of much greater concern in subcontracted companies delivering maintenance, transportation, and rock blasting services, among others.

The tables below, on the Terms of Adjustment of Conduct (TAC)[8] issued by the labor public prosecution offices of Minas Gerais and Espírito Santo states, give an idea of the more frequent violations committed by mining companies.

7. Labor rights violations in the companies surveyed

Of the 24 Minas Gerais companies that were surveyed, 12 had signed TAC agreements for violations, mostly for not complying with health and safety at work standards, particularly with Regulatory Norm 22 regarding safety equipment, yet noncompliance also affects basic hygiene and comfort conditions, flawed occupational health programs, and excessively long hours.

Note of the TruStone secretariat: A list of the companies surveyed and mentioned in the table below is available upon request for TruStone members.

[8] The *Termo de Ajuste de Conduta* (TAC), or Term of Adjustment of Conduct, is an extrajudicial conflict resolution measure whereby the employer pledges to correct irregularities over a given period or otherwise be penalized with a fine or foreclosure.

Company	Year of TAC agreement	Violations
A	2010	Noncompliance with several NR 22 items, including use of explosives, movement of machines; work at height, etc. NR 24 hygiene and comfort conditions; NR7 PCMSO; absence of risk management program PGR.
B	2019	NR 7 (irregular medical checkups).
C	2022	Several NR 22 items regarding massif stability; excessively long hours; unskilled supervision; fine for collective moral damages.
D	2007; 2013	Dust control items; provision of Personal Protective Equipment (PPE), Medical Control and Occupational Health Program (PCMSO); machine guarding; time punch clock.
E	2010	Evaporator heat insulation; monitoring exposure to lithium and feldspar.
F	2021	Continuous transport safety (NR 12); grounding system (NR 10).
G	2010; 2011; 2013	Noncompliance with several NR 22 items; working papers and time punch clock; minimum of 11 hours of rest between workdays not complied with; sanitation and hygiene and comfort conditions.
H	2021	Noncompliance with Brazilian labor code CLT; and with minimum of 11 hours of rest between workdays.
I	2005	Noncompliance with labor code CLT; discrimination against, and dismissal without cause of, union leaders and pregnant women.

J	2000; 2022	Noncompliance with labor code CLT regarding number of hours worked and payment of overtime; procedures and work orders; several safety measures.
K	2013	Several work orders issues; poor training; Risk Management Program (PGR); PPE; and electricity system (NR 10).

Source: Labor Public Prosecution - MG https://www.prt3.mpt.mp.br/servicos/termos-de-ajuste-de-conduta

In Espírito Santo state irregularities are found that are similar to those found in Minas Gerais state. Of the 25 companies included in this study, 15 entered into TAC agreements in different periods:

(Note of the TruStone secretariat: A list of the companies surveyed and mentioned in the table below is available upon request for TruStone members.)

Company	**Year of TAC agreement**	**Violations**
A	2009; 2010; 2012	Several NR 22 items; workday control.
B	2022	Several NR 22 items concerning mine plants and skilled workers; machine and equipment maintenance (NR12); medical checkups and training.
C	2009; 2011; 2017	Problems with workers' payment.
D	2014	Failed setting in place of safety engineering and occupational medicine service SESMT (NR4); noncompliance with NR 22 training requirements.
E	2013; 2014; 2022	Risk management program, massif stability mainly; protection against dusts; workplace organization and training.

F	2010	Several NR 22 items concerning signage, guardrails, mountaintop stabilization and removal; operations with explosives, etc.; issues related to long hours, breaks, rest, and overtime payment.
G	2012; 2021; 2022	Work at height (NR35); operations with explosives.
H	2012	Humidification and respiratory protection.
I	2015; 2016	CIPA internal accident prevention team meetings (NR5); several NR 22 issues (safety signs; pneumatic tools).
J	2011	Lack of training for CIPA accident prevention internal team members; lack of risk management program for the implementation of regulatory norm 22 (NR 22).
K	2012	Noncompliance with technical and safety standards regarding the loading and unloading of stone blocks and slabs.
L	2021	Work at height (NR35); PPE; massif stability and other NR 22 items.
M	2012; 2017	Payment of FGTS severance fund.
N	2010	Weekly rest; NR 22 items (sledgehammers, work organization, restrooms, electric installations, etc.); PPE (NR6); protection against the elements; introduction of risk management program.
O	2014	Poor internal accident prevention team CIPA training; poor occupational health program training; excessively long hours; noncompliance with rest breaks; faulty transportation of marble and granite slabs; signage failure; non-issuance of notification of accident at work CAT.

Source: https://www.prt17.mpt.mp.br/servicos/termos-de-ajuste-de-conduta

This report was unable to confirm whether the violations were rectified or whether they resulted in penalties. Moreover, since inspection mechanisms are weak, it has not been possible to establish if working conditions in companies that were not parties to a TAC agreement are adequate. At any rate, the situations reported in the TAC agreements analyzed are in line with recent concerns of labor inspection as regards the mineral industry as a whole, as reported in the technical feasibility study on the application of regulatory norm NR 22, prepared by Ministry of Labor staff and by other health-care professionals dealing with the mining industry.

In addition to noncompliance with basic safety requirements that can lead to serious and fatal accidents, poor or nonexistent respiratory protective measures that may result in silicosis conditions, flawed training programs and oversight, and other situations indicative of absence of risk management programs commensurate with the complexity of mining working processes, one's attention is also drawn to excessively long hours and to noncompliance with breaks and weekly rest, which in such a demanding job is serious for not allowing physical and physiological recovery of the organism, particularly to respond to dangerous situations.

Noncompliance with basic hygiene and comfort requirements is also striking. Studies have reported that some quarries have no toilets and no drinking water or any water to wash hands and face, inadmissible situations that harm human dignity.

8. Trade union organization characteristics

Trade union organizing and labor relations in Brazil are regulated by labor code CLT, which establishes trade union entities as unions, federations, confederations, and trade union centers, which can represent specific professional groups and liberals. Since its creation, Brazil's labor code, the CLT, has been reformulated, most significantly over the more recent period with the recognition and incorporation of trade union centers, in 2008, through Law 11,648. The labor reform of 2017, Law 13,467, much more comprehensive, affected simultaneously union organization, collective bargaining, working conditions, and access to Labor Justice for grievance resolution. (BELZUNCES:2021)

Taking place in the context of an institutional coup against the Dilma Rousseff people's democratic administration, said reform reduced labor rights and entrenched work casualization through flexible contracts, while at the same time undermining trade union financial sustainability, in addition to reducing the unions' role in collective bargaining processes and in workers' representation. Curtailing still further the possibility of demanding rights, the labor reform imposed restrictions to access the Labor Justice system, including by imposing expert fees, even when workers are entitled to free legal services, rendering it unfeasible for workers to file grievances.

The reform had a disastrous impact on the working class and on the unions, especially the smaller ones, with low unionization and representation rates, a reality that can be seen in every economic sector, including mining. In Brazil, the scope of union representation can be municipal, district, state, intermunicipal, interstate, or national. Union representation can also be organized by economic activity or professional category, thus composing a highly fragmented representation picture. In 2019 there were 11,786 workers' unions officially in effect in Brazil. Official records over the same period showed the existence of 88 trade unions specifically in the mining sector. (BELZUNCES:2021)

One of the difficulties to specify precisely mining workers' union representation is that in some places the workers are organized in unions from different –i.e., extractive, mineral-metallurgy, chemical– industries, which even includes rural workers' unions, a situation possibly related to the diversity of company registrations under the National Classification of Economic Activity (CNAE), to the outsourcing of the right to mining mentioned herein, as well as to each municipality's social and political conditions.

This was a major problem for conducting this study, because we were unable to establish the scope of the workers' union representation for the companies surveyed. According to testimonies by the professionals interviewed, with a few exceptions, in the mining industry there is a prevalence of weak, fragmented union organization, with little power to intervene in working conditions and collective bargaining, both in Minas Gerais and in Espírito Santo states.

In cities where there are more active unions, trade union action is halted by hurdles imposed by most companies. Despite the social importance of labor, overall the notion prevailing in companies is that working places are strictly private spaces, where not only the right of workers to organize is not recognized, but often also government interference is disputed. Actually, in the Terms of Conduct Adjustment agreements surveyed, we find anti-union practices in the mining industry, including dismissal without just cause of union leaders, while it is customary to witness actions designed to hinder activities by unionists inside company premises.

Even when it comes to workers' representation in bodies, such as the accident prevention internal committee CIPAs, the imposition of barriers by employers is quite common.

9. Final considerations

The ornamental stone industry gained momentum in Brazil in the mid-1990s with trade liberalization and regional policies of integration to the global value chains, at the time called "competitive integration", which was about connecting regions of Brazil to the global market by leveraging each region's "comparative advantages". With the dismantling of public planning policies and the undermining of strategic sectoral policies, linked to technology and innovation, Brazilian states and municipalities began to fight to attract private investments (the so-called "tax war") and to seek to

increase their revenues by intensive exploration of their natural resources. Thus ensued a process specializing in extractive and low value added activities that prevailed as a mechanism for the survival of portions of the Brazilian territory that had not been included, or had been poorly included, in the industrial dynamics, which is excessively concentrated in southeastern Brazil, especially in the state of São Paulo.

In this context, export-driven ornamental stone activities flourished, drawing the State's attention to piecemeal sectoral policies, including credit lines extended by BNDES (National Economic and Social Development Bank) to finance exports, a process in line with the need to attract U.S. dollars to support the government's dollar peg. Espírito Santo state has become a key ornamental stone mining cluster, building stone extraction and processing capacity and making it Latin America's most important producer and exporter. Logistic difficulties with the port of Vitória, in Espírito Santo state, caused most exports, financially speaking, to be distributed through the port of Santos, in the state of São Paulo, even though in terms of volume most exports continue to be loaded in the Espírito Santo port. This is so because raw stones are loaded near the mines where they are extracted on account of port limitations, while part of the material processed into slabs is packaged into containers in the São Paulo state terminal.

Shifts in foreign demand also impact the activity regionally, since there is growing foreign demand for aggregates and artificial stones, i.e., porcelain slabs and finished goods, requiring thus a shift in the regions' productive profiles, as they face limitations to grow because of their focus on blocks and slabs. China seems to have taken the lead in this market, engaging in new segments and processing raw stones, even stones imported from Brazil, in order to expand in the U.S. and Arab-countries' markets, large global buyers, ultimately even competing with Brazil. It has been reported that the Asian country was engaged in the offshoring of mining through countries not affected by U.S. embargoes in order to keep its sales while the trade crisis between the two countries is not settled. Nonetheless, it stands to reason that the Chinese appetite for ornamental stones does not only stem from its high-speed civil and heavy construction program, but also from the exploration of technologies that will secure foreign trade hard currency for the country.

In the labor dimension, risks associated with the mining industry remain quite alarming. The likelihood of work-accident fatalities is six times higher in the extractive industry than in all other industries, even if one takes into account that fatal accidents at work in Brazil are, in general, considerably high. Regulatory Norm 22, which regulates safety-and-health-at-work risk management, was not complied with by 70% of the establishments inspected from 2017 through 2020, resulting in 74 injunctions and interdictions of companies that posed imminent risks to the health and integrity of workers.

Equally alarming is the mining industry's poor union organizing, insofar as this restricts interfering in working conditions, both as regards compliance with basic legally-mandated requirements, but also the adoption of new and good management practices, in conformity with national and international guidelines for the protection of workers, throughout the entire ornamental stone industry production chain.

Given the complexity of the situations presented, it is of the utmost importance that studies on the mining sector be continued and that projects be developed that may contribute to bring together the various actors involved with a view to promoting the improvement of working conditions and labor relations, but above all with regard to the workers' health.

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