EVALUATION OF THE PRESENT DEMAND AND SUPPLY OF GEMS, MINERALS AND ROCKS OF AESTHETIC VALUE IN THE EXHIBITIONS ORGANIZED BY THE GEOLOGICAL INSTITUTE OF ROMANIA - NATIONAL MUSEUM OF GEOLOGY

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Abstract: Exhibitions of gems, jewelry, decorative rocks and fossils are taking place at the National Museum of Geology in Bucharest since 2006. In an attempt to evaluate the supply and demand, as well as the cultural and social impact of these events, a protocol was concluded between the Department of Mineralogy of the Faculty of Geology and Geophysics, and the Geological Institute of Romania. An inventory of the exhibits was carried out during November 2017 and June 2018, and details about their origin countries, gemological treatments, processing methods and authenticity were found. The risk of acquiring imitations and synthetic materials becomes more and more higher. Without a good experience to allow a rapid and accurate macroscopic assessment, they can be difficult to distinguish from genuine gemstones. Where possible, gems were verified by X-ray diffractometry.

Key words: gems exhibition, gemological treatments, gems' sources, gemological varieties, quiz.

I. INTRODUCTION

In our country, the Geological Institute of Romania trough the National Museum of Geology (NMG) is the traditional host of the sales exhibitions of gems, jewelry, minerals and rocks of gemological quality. Interesting is that the events are connected to important religious holidays and/or traditional festivals, providing the opportunity to make good business. Thus, the most modern trends in the processing of minerals and rock gems can be admired, getting information about treatments applied to them, and obtaining certifications and advice from experts.There is a wide range of minerals and rocks that came from Romania, as well as around the world. The gems are either rough, rolled orfaceted, either in advanced processing stages, including heat or chemical treatments to improve their quality. The most modern trends in the processing of minerals and rock gems can be admired, getting information about treatments applied to them and obtaining certifications and advice from experts.

For visitors, quiz about color preferences was elaborated, as well as about processing and intervention through various procedures on raw material, also about the degree of product information. Another question was about the purpose for which the gems are purchased, knowing the tendency to be used increasingly more in alternative medical therapies. For exhibitors, questionnaires were focused on origin countries of crystals and rocks, how to purchase (personally or through intermediaries, participation in international fairs), and also on the possibility to check the quality and authenticity of gems and decorative rocks. In order to confirm the authenticity of the gems, some of the dealers allowed extracting fragments of mineral and rock exhibits for RX diffraction, using the equipment of the Geological Institute of Romania. X-ray powder diffraction analyses were performed on a Bruker D8 Advance automated diffractometer equipped with a graphite-diffracted beam monochromator (Cu $K\alpha$ radiation, λ = 1.54056 Å), at an operating voltage of 40 kV and a beam current of 40 mA, ICDD PDF Release 2013 data base, soft including Diffrac Basic (Eva V3.1) and Topaz 4-2 programs.

II. RESULTS AND DISCUSSION

Questionnaires designed for 15 dealers and retailers focused on the origin countries of the gem-quality stones which they sell: Brazil, India, China, South Africa, Peru, Afghanistan, Russia and Madagascar. Other countries, such as Argentina, Mexico, the USA, Canada, Namibia, Congo, Ethiopia, Morocco, Myanmar, Dominican Republic, Australia, Turkey, as well as European countries like Germany, Spain, Norway, the Czech Republic and France, contribute to a lesser extent to the shaping of the Romanian gem market. Some specimens come from the former famous mining areas of Romania (Baia Mare, Apuseni Mountains, Banat). The exhibits are purchased personally or through intermediaries, usually from international gems exhibitions and trade fairs in Germany, France, USA, rarely directly from the origin countries. Many of the gems found at these international events (Tab. 1) are originally transported to India, where they are often processed and then sold to collectors and dealers. The of exhibitors who participate to the NMG events sometimes ask the expertise of GIR specialists for gems certification. Some of them are geologists, or have specialized gemological training.

70 questionnaires designed for visitors were distributed and received answers are illustrated in Fig. 1.

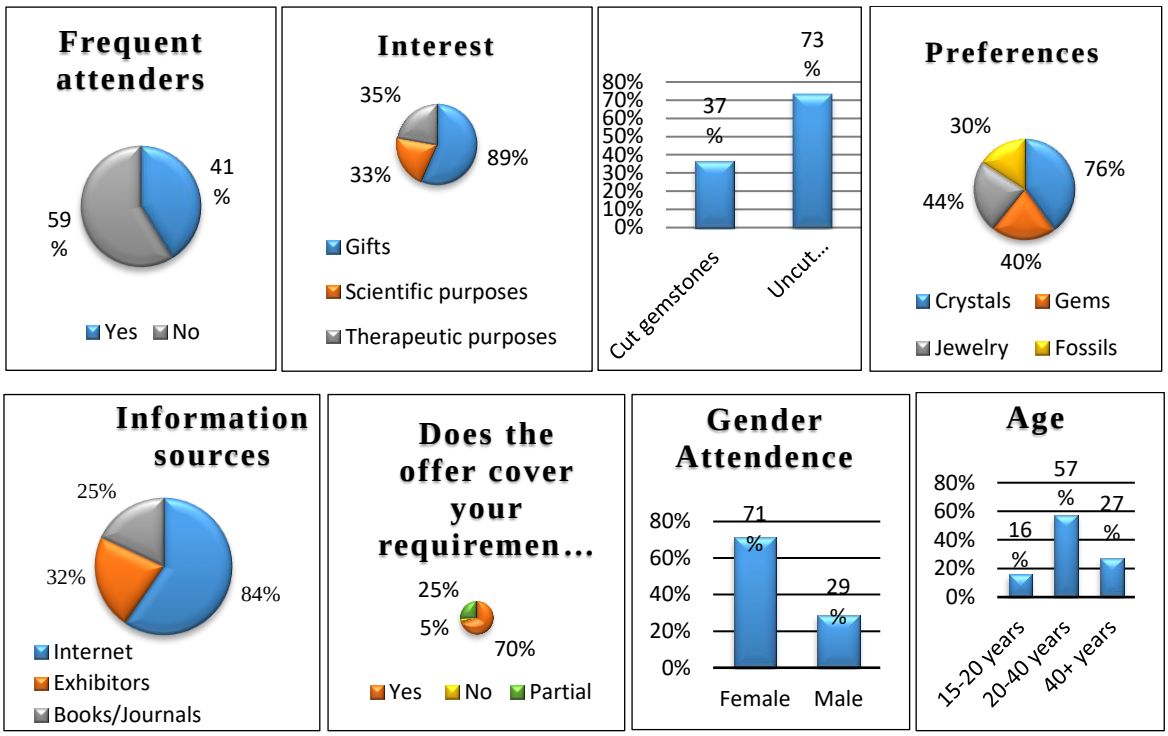
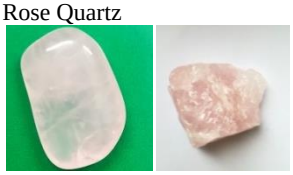
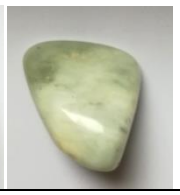


Fig. 1. Received answers form the visitors to the questionaires.

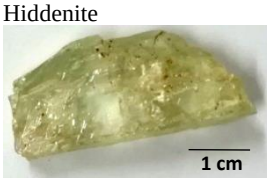
Table 1. The most spectacular minerals and rocks with gemological properties marketed in the NMG exhibitions (November 2017-June 2018).

MINERAL / *ORIGIN COUNTRIES*	**CHEMICAL COMPOSITION** The New IMA List of Minerals – A Work in Progress – Updated: March 2018	**GEMOLOGICAL VARIETIES**	**MACROSCOPIC DESCRIPTION**
Beryl *Madagascar* *Brazil* *Russia*	$Be_3Al_2Si_6O_{18}$	Morganite (Rose Beryl) 	Rare variety of beryl. Rose color with an intense lilac shade. Fine brown inclusions into internal cracks. Dichroic. Non-heat-treated for the rose color improvement. The crystals with a strong rose color are the most valuable (Andrei, 2013).
		Aquamarine (Blue Beryl)   	A distinct greenish blue to blue color, due to the low content of iron oxide (Fe^{2+}). Few inclusions and fractures.Dichroic. Pale greenish cloudy and almost opaque in beads for necklaces, earrings and bracelets. Some of them present the *chatoyant* effect. There are raw, greenish-blue stones, and it is assumed that they were not heat-treated for color intensification (Crowe, 2007). Others have probably been heat-treated to get the pale blue or the dark blue of the so-called *Brazilian aquamarine*, the most popular (Andrei, 2013).
		Heliodore (Gold Beryl) 	Less intense yellow, meaning a low Fe content. But the color can often be changed by heating and irradiation, so treatments cannot be excluded. Internal fine cracks and a relatively good transparency. Because it can be mistaken for peridot, chrysoberyl and some tourmaline varieties (Andrei, 2013), it was subjected to the RX investigation. Rarely used in jewelry, because of the absence of brightness.

		Goshenite (White Beryl) 	Incolore specimene of beryl. Free of inclusions. Rarely used in jewelry, excepting just this pure appearance named *the mother of gemstones.*
Corundum *India*	Al_2O_3	Sapphire 	*Geuda* type (Andrei, 2013). Inferior gemological varieties, green to yellow-green color, because of the less Fe content in comparison with the most valuable and expensive blue to violet sapphires. Fine inclusions and a relatively low transparency. RX tested.
		Ruby  	Darkred color and lack of transparency show that rubies are of inferior quality. Thermally untreated (heating can remove inclusions and improve the clarity). Ruby cabochons in zoisite, zoisite ruby and dark red ruby in necklaces, earrings and bracelets. RX tested.
Chrysoberyl *Russia* *South Africa*	$BeAl_2O_4$	Alexandrite 	Genuine alexandrite displays a color change (*alexandrite effect*) depending upon the nature of ambient lighting (*metamerism*). Never observed in the case of alexandrite marketed in the NMG. Russian pendants of red-raspberry alexandrite. Raw bicolored green to dark green stones, with a relatively low transparency (South Africa). It can be mistaken for topaz, beryl, peridot and tourmaline. RX tested.
Quartz *India* *Uruguay* *Brazil* *Madagascar* *Bolivia*	SiO_2	Amethyst 	A purple variety of quartz. Sometimes bicolored crystals. The color is due to the presence in the crystalline structure of Fe_2O_3 and Al_2O_3. The most popular gem in NMG: raw and faceted crystals, cabochons and beads in silver for earrings, rings, trinkets or pendants. It can be mistaken for fluorite, kunzite, spinel, tourmaline, topaz and tanzanite (Andrei, 2013). RX tested.
		Citrine 	Yellow to brownish-colors, by the presence of iron and aluminum traces in the crystalline structure. It is the most popular quartz variety in NMG after amethyst: beads, pendants raw and faceted crystals. As gemologists mention, about 10 to 30 % of the total citrine found on the market is synthetic, being almost impossible to distinguish from the natural one. It can be mistaken for beryl, topaz, sapphire, tourmaline and zircon (Andrei, 2013). RX tested.
		Aventurine 	A variety of translucent quartz with abundant small plate- or flake-shaped of fuchsite mica inclusions. Aventurine is usually green, but also brown, gray and blue. Beautiful beads and cabochons.

		Rose Quartz 	Color ranges from a very light to a rich translucent pink. The pink color is attributed to microscopic inclusions of minerals containing Ti, Mn, Fe, Al, Li (Andrei, 2013). Sold as rawandfacetedcrystals, jewelry made of spheres or cabochons presenting the phenomenon of *asterism*, necklaces, ashtrays, cassettes.
		Ametrine 	Is a variety of rare bicolored quartz presenting amethyst and citrine in contact with one another in a single crystal. Almost all of the world's commercial ametrine comes from Anahi Mine in Bolivia (Andrei, 2013).
		Smoky quartz. *Cairngorn quartz. Morion* (black) 	A grey, translucent variety of quartz that ranges in clarity from almost complete transparency to an almost-opaque brownish-gray (smoky quartz) (*Cairngorn quartz*) or black crystal (*morion*). The color is due to the presence in the crystal lattice of aluminum and/or lithium (Andrei, 2013). Some samples show rutile needle inclusions. Faceted crystals in white metal mount.
Jadeite *Nephrite* *China* *Canada* *Africa*	$Na(Al,Fe)Si_2O_6$ $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ *Gem Reference Guide*. Gemological Institute of America 1988.	*Jade*   	As a result of iron content, green jadeite has a typical marble appearance and a resinous luster. RX tested. Nephrite is exposed as various shades of cream-colored (rich in magnesium), and also as white and dark green (due to the presence of iron oxide) (Crowe, 2007), sometimes gray. Both are durable, colorful materials that are admired and sold in the NMG exhibitions as jewelry (bangles), art and decorative objects (carvings). Jadeite jade is rarer and generally more valuable than nephrite.
Malachite *Russia* *Congo*	$Cu_2(CO_3)(OH)_2$	Malachite 	All specimens are green and range from a pastel green to an extremely dark green. Made in silver for earrings, bracelets and pendants. Also decorative and luxury objects (carvings, ashtrays, cassettes). RX tested.
Spinel *India* *Myanmar* *Madagascar*	$MgAl_2O_4$	Gahnit. Gahnospinel *Burma Spinel* 	Greenish-purple blue stones cheaper and less sought than other color spinel (Crowe, 2007). It is one of the few gemstones that can be purchased with the certainty of being natural, as it is rarely treated thermally or irradiated to intensify or change the color. Made in silver for earrings, bracelets and pendants. It can be mistaken for corundum, zircon, tourmaline, amethyst and garnet. RX tested.
Fluorite *China*	CaF_2	Fluorite 	Typically purple, green, and yellow. Also colorless, blue, red, and black. Specimens with exceptional diaphaneity and color are found as unpolished crystals or beaded stone, and as beautiful cabochons. Also art and ornamental objects (ashtrays, vases, clock dials). RX tested.

Turquoise *USA* *Tibet* *Iran*	$CuAl_6(PO_4)_4(OH)_8 \cdot 4H_2O$	Turquoise 	Shades of blue, bluish green, green and yellowish green. Made in silver in beads for necklaces, earrings, rings, trinkets or pendants. Treatments that even traders do not know about (reconstitution, pressing, stabilization, and painting) are not excluded (Crowe, 2007). Because of the frequent use of howlite and magnesite imitations (Andrei, 2013), it was RX tested.
Tourmaline *Madagascar* *India*	$NaMg_3Al_6(BO_3)_3[Si_6O_{18}](OH)_4$	Dravite 	Brown-yellow color due to the presence of magnesium in the mineral network (Crowe, 2007). Dichroic, with two different colors when viewed from different angles.
	$CaMg_3Al_6(BO_3)_3[Si_6O_{18}][(OH)_3O]$	Uvite 	The official IMA name for this mineral species is ***uvite*****,** redefined as part of a nomenclature revision of the Tourmaline group (Henry *et al*., 2011). Beautiful green crystals occasionally striated. RX tested.
	$Na(Al_{1.5}Li_{1.5})Al_6(BO_3)_3[Si_6O_{18}](OH)_4$	Bicolored Elbaite *Watermelon* *Pink elbaite*   	It is most used in jewelry. The green color of the *watermelon* variety is due to ferric ions, chrome or vanadium. Manganese in the crystal network usually gives the pink color (Andrei, 2013). Raw bicolored pink elbaite crystals, watermelon elbaite in copper mounts. The higher the colors contrast and the more transparent elbaite is, the more expensive it is.
	$NaFe_3Al_6(BO_3)_3[Si_6O_{18}](OH)_4$	*Schorl* 	Ferric black tourmaline. It can be mistaken for onyx, with which it is sometimes substituted. Used like mourning stone (Andrei, 2013), in silver mounts.
Lazurite *Afghanistan* *Iran*	$(Na,Ca)_8Si_6Al_6O_{24}[(SO_4),S,Cl,(OH)]_2$	*Lapislazuli*  	Lazurite is the blue component of the gemstone or, more usually, ornamental rock *lapislazuli*. It is an ultramarine to midnight-blue, opaque mineral, often containing calcite inclusions. Sold as jewelry (cabochon, boards, drops, spheres), art and decorative objects (cassettes, ashtrays, statuettes). Treatments are not excluded in order to obtain a uniform color by masking calcite diaclases. Substitueted by synthetic spinel or blue glass paste (Andrei, 2013). It can be often mistaken for azurite. RX tested.

Topaz *Brazil* *Ukraine*	$Al_2SiO_4(F,OH)_2$	*Imperial topaz.* Rare and precious bicolored topaz   Light yellow topaz.	The color ranges from colorless to yellow-orange (*imperial topaz*), brown and pink yellow, as well as rare bicolored topaz crystals. Light yellow topaz has a lower gemological value. Thermal treatments are not excluded, by which the defects in the crystalline network are repaired, with the transformation of light yellow to pink or pink-orange color, belonging to the most sought-after topaz varieties (Andrei, 2013). It can be mistaken for citrine or smoky quartz.
Pectolite *Dominican Republic*	$NaCa_2Si_3O_8(OH)$	*Larimar. Lorimar* 	Calcium substitution by copper produces the blue color. Also called *Stefilia's Stone*, is a rare blue variety of pectolite found only in the Dominican Republic. An intense silky chatoyance can be observed (http://www.jmarcano.com/mipais/recursos/larimar2.html).
Spodumene *Afghanistan* *USA* *Pakistan*	$LiAlSi_2O_6$	Kunzite 	Pink to lilac specimens of gem-quality spodumene. The color is attributed to the presence of manganese as a chromophore. Greasy luster. Kunzite is the most commonly encountered gem spodumene. Very hard to cut and polished (Crowe, 2007).
		Hiddenite  	Rare green variety of the gem spodumene. The color is atrributed to the presence of chromium as a chromophore. Only light green hiddenite. The dark green stones are even rare and very expensive (Crowe, 2007), and they are not marketed yet in the NMG exhibitions.
Prehnite *India*	$Ca_2Al_2(Si_3O_{10})(OH)_2$	Prehnite  	Typically silky semi-transparent to translucent. Usually yellow-green to apple-green or mint green. Faceted shiny beads sometimes with black tourmaline inclusions. It can be mistaken for nephrite, jadeite, chrysoprase and peridot (Crowe, 2007).

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