EMERALDS FROM AÏR MOUNTAINS (NIGER)

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INTRODUCTION

So far, the only known emerald deposits in Western Africa were those from Nigeria: the Gwantu and Nassarawa Eggon areas (Figure 5) have produced emeralds since the beginning of the 1980's (Bank, 1984; Lind et al., 1986; Kanis and Harding, 1990; Arps and Zwann, 1995; Schwarz et al. 1996; Michelou, 2007). These emeralds belong to a unique geological type (Giuliani, 2022), associated with granitic pods, and referenced as type Ic according to the classification proposed by Giuliani et al. (2019). They are interesting particularity as they host multiphase fluid inclusions similar to those emeralds coming from Colombia and Afghanistan (Schwarz et al., 1996, Giuliani et al., 2019).

The light color displayed by emeralds from these deposits was the topic of some debate regarding the correct varietal terminology to be used; green beryl or emerald. Various opinions are regularly expressed. Nevertheless, in this study we consider that a very light colored stone can be called emerald as long as its colour is due to the presence of chromium (Cr) and/or Vanadium (V). Indeed, light colored stones from Colombia or Afghanistan hosting sometimes nearly colourless areas are still considered to be emeralds. On the other hand, if the color is due to iron (Fe), then we would speak of green beryl. Thus, the presence of low amounts of Cr and V in Nigerien stones, including the Nigerien stones in this study, allows them to be termed emeralds. (Hänni, 1992, Giuliani et al, 2019).

Recently, other emerald occurrences of a type similar to those in Nigeria (associated with granites) have been discovered in the Hoggar, in southern Algeria (Hamis et al., 2021) and in the Aïr massif in Niger (Figure 5), the focus of this work

Figure 5: Google Earth map showing the different emerald occurrences in Niger and neighboring countries (Algeria in the North and Nigeria in the South) discussed in this study. Note: the Kontagora area was added in Nigeria where an emerald discovery reportedly took place in 2020, but the authors were not able yet to study these emeralds and confirm the existence of this new deposit.

Because of the complicated security situation in Niger and more particularly in the Aïr area and the difficulties with covid-19 travel, it was not possible to plan a field expedition to this interesting area. Nevertheless, this article provides for the first time some background on the history of gemstone prospection in Niger and the subsequent discovery of some emeralds deposits thanks to the input of author Sylvain Leroux (SL), an international solidarity volunteer who worked from 2005 to 2006 with artisanal cassiterite miners in Elmeki as part of a development project.

We present here the first results of the gemological analysis of the emeralds SL collected from Niger which were studied by ICA | GemLab in Bangkok.

The bibliography related to the geology and mineral resources of the Aïr granitic massifs in Niger is somewhat limited. Some references relating to the presence of "beryl" in this region are reported by the Mineral Plan of the Republic of Niger (1983), following the inventory of beryllium resources. Occurrences of "beryl" have been found in an alkaline biotite granite, located southwest of the camp of the former Société Minière Dahomey Niger (SMDN), at Taraouadji, as well as in granitoids at Elmeki. According to Amadou Dan Malan, a local contact in Elmeki, the first small scale mining work was undertaken in 2004 by Mamadou, a trader and exporter of cassiterite from Elmeki to Nigeria. During his visit to Jos in Nigeria, Mamadou acquired some knowledge about emeralds and he started prospecting for them in the Elmeki region.

In 2004, an emerald rich vein was discovered and excavated to about fifteen metres long and to a depth of about 8 metres, east of Mont Arnaud on the Inzareg site. Crystals of lightly colored transparent emeralds, about 8 mm in diameter, were discovered in this vein and sold in Nigeria by Mamadou. In 2005, author SL visited the site.

Exploration and collection of green beryl from Elmeki continued, after the end of the development project in March 2006, by the artisanal miners of Elmeki with the support of SL (Figure 6 and Figure 7). In 2016, the prospection work carried out by SL to the east of Mont Arnaud, led to the discovery of small emeralds (less than one centimeter in size), of very variable colour but very rarely of gem quality.

In October 2020, a local contact of SL, in charge of spotting new minerals arriving on the Agadez market, mentioned the discovery of "green stones" by a team of gold prospectors in the Taraouadji massif. The entire production, about twenty well crystallized gem crystals with well-developed prisms and basal pinacoids, reaching 5 cm in length, was acquired by the authors (Figure 8). The precise location of this discovery in the Taraouadji massif is presently unknown and the occurrence was not visited by the authors. Nevertheless, production reportedly continued after the acquisition of this first batch by author SL.

Figure 6: Local miners near one of the Elmeki (Inzareg) occurrences mined for beryl in the Aïr Massif in Niger. Photo by Sylvain Leroux

Figure 7: Group of local miners looking for emeralds near Elmeki (Inzareg) in the Aïr region of Niger. Photo by Sylvain Leroux.

Figure 8: Emerald crystals (between 4 and 17 carats) reportedly found around Taraouadji in the Air massif in Niger that were analyzed as part of this study. The largest crystal (left) is about 5 centimeters long and weighs 17 carats. Photo taken in natural light in Bangkok by Vincent Pardieu.

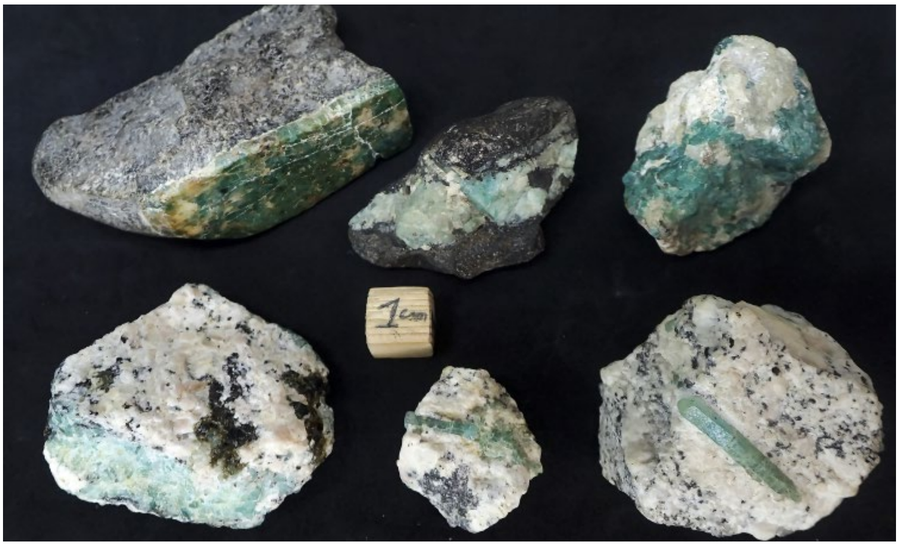

Figure 9: Emeralds on pegmatitic matrix associated with biotite from different mining sites located around Mount Arnaud near Elmeki. Collection and Photo: Sylvain Leroux.

The emerald mineralization observed in the Aïr is associated with the anorogenic intrusions i.e. the "Younger Granites" which were set up in the Aïr massif between the Ordovician for the annular massif, the northernmost (Adrar Bous, about 487 million years ago, Ma) and the Devonian for the annular massif, located the southernmost of Aïr (Taraouadji, about 401 Ma).

There are twenty-eight intrusive massifs, annular to ellipsoidal whose petrographic and chemical composition as well as structures are variable, which are aligned from north to south of the Aïr (Raulais, 1959, Black et al., 1967). They are part of the larger province of "Younger Granites" joining from northern Niger to the Bauchi plateau in Nigeria. The granitoid intrusions of Nigeria being more recent and dated to the Jurassic. From a metallogenic point of view, cassiterite and emeralds from Niger are associated with alkaline biotite granites, resulting from the last phase of differentiation of "Younger Granites" (Moreau et al, 1994, Liégeois et al., 1994, Black et al., al., 1994; Romex, 2017).

At Elmeki and around Mont Arnaud, green beryl is found in pegmatite veins that cut clusters of black biotite (Figure 5). They are about 10 to 20 cm wide, and are formed of potassium feldspar, biotite, little quartz and sometimes brown fluorite.

GEMMOLOGY OF EMERALDS FROM NIGER

MATERIALS AND METHODS:

Figure 10: 13 emerald crystals (between 0.17 and 4 carats) from Elmeki in the Air massif in Niger used in this study. The largest crystal on the left is about 1.5 centimetres long. The small 0.17 carat green gemstone (to the right of the left trio) was polished to obtain UV-Vis-NIR and FTIR spectra. Photo using natural light in Bangkok by Vincent Pardieu.

Thirteen emeralds mined in the Elmeki region (Figure 10), and four crystals reportedly produced near Taraouadji in 2020 (Figure 8) were acquired by Vincent Pardieu (VP) from the personal reference collection of SL. SL collected the thirteen samples from cassiterite miners in Elmeki and from other small pegmatites located around Mont Arnaud (Tagomass, Egazar, etc.).

The 4 samples reportedly from Taraouadji were obtained from a local trader in 2020. All the samples were sent to author SL from Niger to Belgium and then from Belgium to Bangkok. All samples are then of "F-Type" according to the classification proposed by Pardieu (2009, 2019). They consist of crystals of different colours ranging from pale green to intense green. Five samples from the Elmeki region were selected and fabricated with windows polished perpendicular and parallel to the c axis for spectroscopic analysis. The remaining samples were used for chemical and inclusion studies performed at ICA | GemLab in Bangkok, Thailand.

RESULTS AND DISCUSSION

MICROSCOPIC CHARACTERISTICS

The most common inclusion features in the emeralds from Elmeki and Taraouadji, in this study, are multiphase fluid inclusions with a liquid, a gas bubble and at least one or more solids including the ubiquitous cubic-looking crystal (Figure 11, Figure 12, Figure 13 and Figure 14) which is undoubtedly salt (halite). These inclusions are generally found as primary cavities aligned along the direction of the c axis or as secondary type ones with "veil type" healed fissures without any particular alignment. It is noted that in the emeralds of Taraouadji the gas bubbles seem more voluminous compared to the crystals of halite than in the emeralds of Elmeki (Figure 13 and Figure 14). In both cases they commonly present a jagged-type aspect, very similar to those seen in emeralds from Nigeria (Schwarz et al., 1996), Colombia, Afghanistan, Davdar in China or Musakashi in Zambia (Saeseaw et al., 2014).

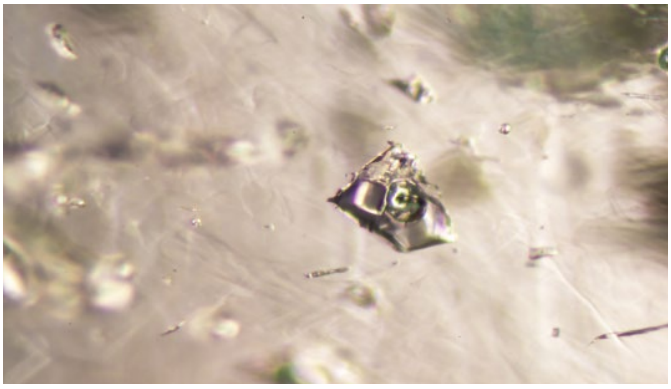

Figure 11: Fluid inclusions trapped by the emeralds of Elmeki in Niger, field of view 2 mm. Image by Sarocha Luetrakulprawat / ICA l GemLab

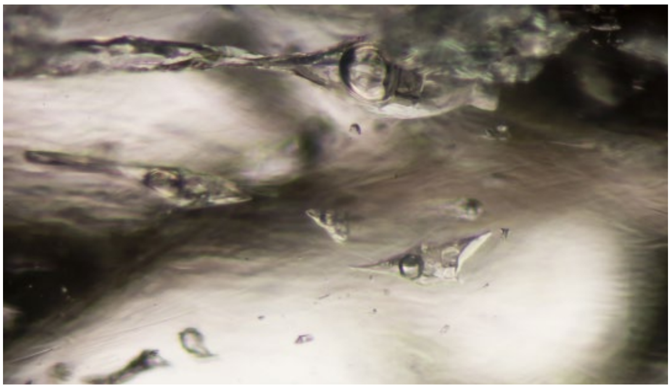

Figure 12: Fluid inclusions trapped by the emeralds of Elmeki in Niger, field of view 2 mm. Image by Sarocha Luetrakulprawat / ICA Gem Lab

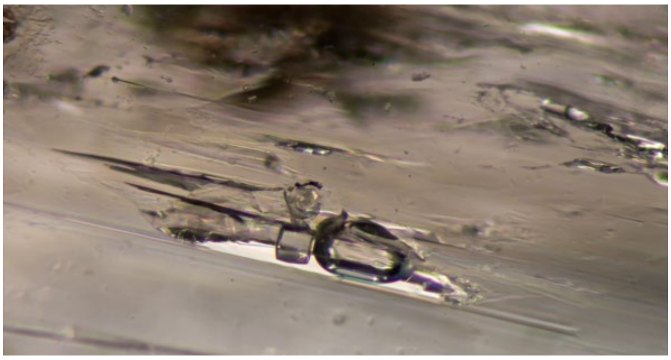

Figure 13: Fluid inclusions trapped in emeralds from Taraouadji in Niger, field of view 2 mm. Image by Sarocha Luetrakulprawat / ICA l GemLab.

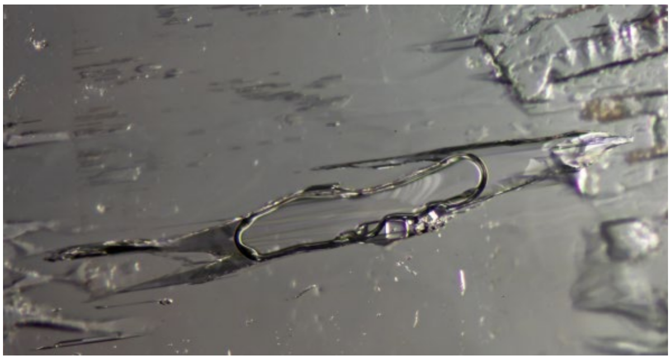

Figure 14: Fluid inclusions trapped in emeralds from Taraouadji in Niger, field of view 2.2 mm.. Image by Sarocha Luetrakulprawat / ICA l GemLab

Note the irregular shape of the inclusions in Figure 11 and Figure 12 (generally with a pointed or needle-like appearance) and the presence of at least one solid phase in the form of a cubic crystal of halite. This kind of scene is also very similar to that observed for emeralds from Nigeria but also those from Colombia, the Panjsher Valley in Afghanistan and the Davdar region in China.

The classic jagged-type aspect to inclusions that is commonly associated with emeralds from some Colombian deposits may be seen within emeralds from Taraouadji studied (see. Figure 13 and Figure 14).

The UV-Vis-NIR spectrum obtained on the 0.17 carat emerald revealed electronic transitions of Cr and Fe (Figure 15). The most important features were Cr^{3+} absorption bands at about 430, 600, 639 and 683 nm, Fe^{3+} absorption at 372 nm, and the Fe-related feature at 810 nm. The presence of significant contribution of chromium in the spectra of these stones confirm the varity terminology as emerald despite their light coloration. The Fe features found here are similar to those found in the spectra of schist-hosted emeralds from localities such as Brazil, Ethiopia, Russia and Zambia (Karampelas et al. 2019) and from emeralds associated with granites such as those of Nigeria (Schwarz et al., 1996). It is interesting to note that these iron absorptions are absent in iron-poor emeralds such as those from Colombia (formed in argillites, Type IIB of the classification proposed by Giuliani et al., 2019) or are very low in the case of emeralds from Afghanistan or from Davdar in China (Type IIC; see Pardieu et al. 2020, 2021).

The FTIR spectrum (Figure 16) shows a combination of bands linked to type I and type II water in the structure channels of emerald (Wood and Nassau 1968); there are a series of bands between 4500 and 6000 cm^{-1} with main band around 5270 cm^{-1} (Figure 16). Bands related to the presence of water were also observed between 6500 to 7500 cm^{-1} (Karampelas et al., 2019). Two different FTIR spectral structures can be observed. The sample cut parallel to the c axis shows main peaks at 7140, 6810 and 5270 cm^{-1}.

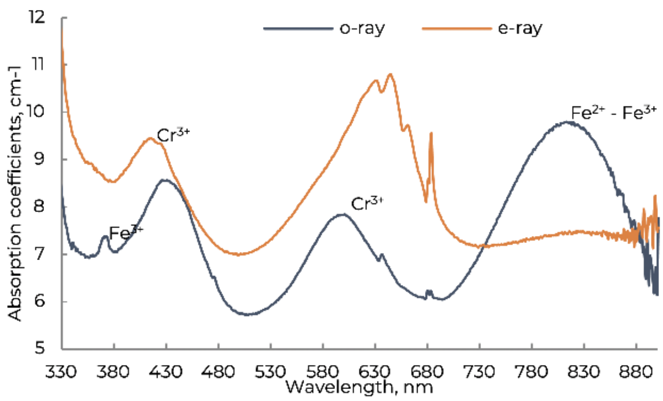

Figure 15: UV-Vis-NIR spectra (o and e rays) of an emerald from the Elmeki region in Niger (0.17 carat stone in figure 6 which contains about 1000 ppm of chromium, 300 of vanadium and 4000 of iron). The main chromophoric elements are chromium and iron.

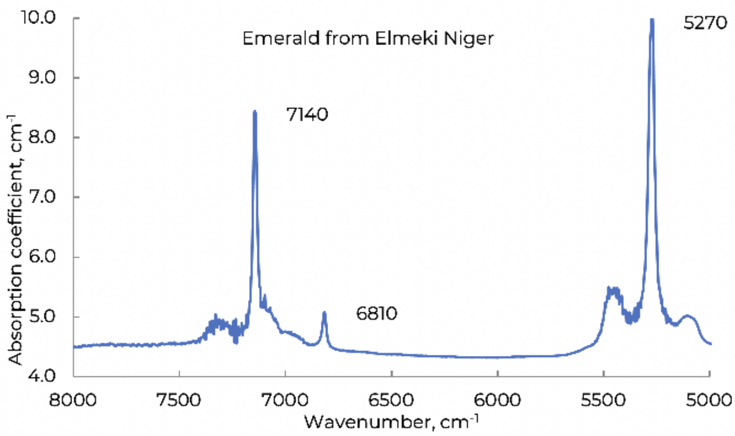

Figure 16: FTIR Spectrum of the same 0.17ct Niger emerald as used for the UV-vis-NIR, Figure 15. Peaks due to the presence of water in the emerald channels.

TRACE ELEMENT CHEMISTRY USING LA-ICP-MS:

The trace element chemistry results using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) are presented in Table 2 and Table 3. The analyses reveal the presence of minor amounts of Na, Mg, V, Cr and Fe as well as only traces of Li, K, Sc, Ti, Mn, Co, Ni, Zn, Ga, Rb and Cs. The Cr, V and Fe chromophores are present in significant quantities. We note that the alkali content (Li, Na, K, Rb, Cs) is rather low.

Table 2: LA-ICP-MS data for 12 emeralds from the Elmeki region in Niger. Data was collected from 3 or 4 spots on each stone. The numbers in blue indicate that the content is below the detection limit (BDL), those in red are below the quantification (BQL) limit of the instrument).

Elmeki Niger	**7Li**	**23Na**	**24Mg**	**39K**	**45Sc**	**47Ti**	**51V**	**52Cr**	**55Mn**	**56Fe**	**59Co**	**60Ni**	**66Zn**	**69Ga**	**85Rb**	**133Cs**
EM-ELMEKI-FAB-1.69CTS SP1	94.5	1100	41	37.1	23	15.4	112	35.3	8.63	3780	0.53	< 4.083	57.5	30.3	18	29.8
SP2	49.8	1020	93.1	36.24	80	24.5	792	80.7	8.66	4290	< .097	< 1.361	18.2	41.4	14.6	37.3
SP3	88.4	1060	33.1	40.4	23.2	8.43	115	43	8.37	3910	0.36	< 1.361	69.7	33.3	17.9	30.2
SP4	29.8	837	78.6	53.9	62.3	18.1	522	16.4	6.55	4390	< .291	< 1.361	7.12	46.7	13.4	43.2
EM-ELMEKI-FAB-1.15CTS SP1	17.4	799	296	138	125	33	532	375	9.05	3320	0.72	< 1.361	48.9	28.5	27.9	102
SP2	11.2	757	371	165	92.6	16.7	485	443	8.47	2880	0.49	< 1.361	30.2	26.2	34	77.5
SP3	13.8	634	265	116	105	21.7	551	602	5.18	2700	< .291	< 1.361	31.5	27.9	26.8	63.2
SP4	12.8	754	396	160	89.1	16.4	508	402	6.09	2690	0.31	< 1.361	22.1	26.5	31.6	81.8
EM-ELMEKI-FAB-0.43CTS SP1	15.5	659	386	419	32.6	13.8	130	1290	8.42	3080	0.71	6.41	120	15.2	57	7.85
SP2	13.9	626	358	435	30.1	17.6	121	1160	8.59	3230	0.88	< 4.083	112	15.4	54.5	7.09
SP3	13.4	629	323	371	46.7	18.7	197	1950	8.15	2940	0.7	< 4.083	98.9	19.7	48.8	10.8
SP4	16.2	666	389	433	48.7	21	239	1740	9.87	3740	0.93	< 4.083	106	17.9	60.9	12.9
EM-ELMEKI-FAB-0.39CTS SP1	35.1	1400	163	71.7	109	7.68	1150	743	10.6	6320	0.43	< 4.083	28.3	32.2	19.6	56.2
SP2	49.6	1220	93	53.9	30.3	10.8	564	553	9.43	5320	0.49	< 4.083	19.2	21.6	21.3	38.2
SP3	39.4	1510	129	75.7	104	10.2	1130	764	10.5	6310	< .291	< 4.083	25.7	36.1	18.7	56.1
SP4	56.4	1300	84.7	67.3	34.8	11.8	561	586	10.5	5340	< .291	5.08	25.5	23.7	18.3	39.1
EM-ELMEKI-FAB-0.17CTS SP1	38.2	883	258	212	82.9	45.7	348	1050	10.7	4190	0.54	5.98	42.2	24.5	40.8	45.6
SP2	44.5	1050	257	219	84.5	61.2	348	1120	11.8	4410	0.63	5.79	41.9	27.6	42.8	48.7
SP3	40.5	842	254	222	86.9	43.2	342	1090	11.9	4260	0.53	4.56	33.1	25.7	40.7	46
SP4	41.1	915	255	181	87.8	61.4	316	1000	10.9	4300	0.37	7.63	39.1	26.7	42.7	50.2
EM-ELMEKI-01 SP1	14.1	849	370	367	48.1	12.5	231	4270	7.76	3390	0.55	5.42	87.4	17.9	65.6	29.5
SP2	17.5	880	447	483	49.4	23.4	327	4570	8.76	3870	0.93	5.83	112	18.7	73.1	30.2
SP3	14.3	949	398	536	48.3	13.8	225	3860	8.57	3700	1.21	5.14	113	19.4	76.6	30.7
EM-ELMEKI-02 SP1	22.2	751	358	226	131	19.7	560	1320	6.33	2630	0.3	< 4.083	29.2	28.6	39.1	98.3
SP2	17.8	673	331	180	152	24.4	615	1650	8.67	2830	0.33	< 4.083	21.3	28.2	35.2	100
SP3	18.8	772	336	164	148	25.4	656	1580	6.91	2620	0.65	< 4.083	23.8	31.1	29.2	97
EM-ELMEKI-03 SP1	11.3	787	352	166	36.3	14.7	137	134	3.98	2210	0.39	< 4.083	34.3	20.7	27	10.3
SP2	9.25	607	285	162	43.7	16.7	98.6	132	3.67	1890	0.62	< 1.361	31.2	22.7	24.6	7.29
SP3	10.4	609	328	175	41.5	21.1	100	123	3.37	2140	0.58	< 4.083	35.5	24	26.4	7.18
EM-ELMEKI-04 SP1	14.6	751	460	543	72.8	24.7	230	1420	12.7	3850	1.27	4.15	105	23	73.4	18.2
SP2	15.9	721	459	572	56.5	17.6	281	2310	10.3	4110	0.81	4.66	96.2	23.1	67.1	17.4
SP3	15.5	703	406	537	44.6	18.9	261	3160	9.3	3580	0.92	4.1	137	22.2	62.4	12.8
EM-ELMEKI-05 GREEN SP1	26.1	1270	299	114	125	24.5	898	2020	9.59	3690	0.46	< 4.083	19.1	25.3	30.5	111
SP2	23.1	1670	322	107	135	15.2	979	2180	12.2	4200	0.46	6.19	21.3	29.3	36.8	122
SP3	22.8	1190	324	91.9	135	25.5	926	2210	12.5	3840	0.41	< 1.361	34.4	29.9	33.3	129
EM-ELMEKI-05 WHITE SP1	20.9	2250	376	110	263	41	762	263	9.34	3900	0.57	< 4.083	21.4	19.7	30.6	72.6
SP2	21.3	2110	507	169	361	34.6	279	8.97	16	6640	0.75	5.21	24.7	17	56.4	103
SP3	25.3	3710	402	116	170	80.3	733	71.2	10.9	4230	0.68	< 4.083	29	19.7	37.5	75.8
EM-ELMEKI-06 SP1	27.9	941	319	246	71.9	45.4	459	2650	12.9	4330	0.84	5.59	16.1	27.9	52.4	78.4
SP2	28.2	976	346	264	69.4	44.8	505	2990	15.2	4700	0.7	5.85	23.1	28.7	54.4	74.2
SP3	29	946	328	323	73.1	33.2	480	2930	11.6	5620	< .291	8.77	28.3	27.9	56.9	82.8
EM-ELMEKI-07 SP1	59.4	1620	152	88.9	108	9.97	874	145	13.1	6110	0.34	< 1.361	8.12	39	27.1	79.2
SP2	49.5	1500	143	62.6	95.8	15.5	831	173	13.7	5760	< .291	< 4.083	8.19	37.4	25.9	74
SP3	54	1440	141	65.2	95.5	8.91	721	157	10.5	5590	0.88	< 1.361	9.42	36.6	23.6	77.2
EM-ELMEKI-08 SP1	23.5	819	319	231	112	24.6	982	3280	5.89	3020	0.33	< 4.083	34.6	30.7	40.9	126
SP2	25.6	833	374	248	130	25.1	967	3330	8.32	3230	0.67	4.74	28.6	31.8	42.9	125
SP3	20.4	866	374	237	132	21.7	849	3340	9.73	3510	0.33	4.71	23.9	28.5	40.6	136
Detection limit (ppmw)	**0.271**	**13.11**	**0.409**	**12.08**	**0.737**	**2.56**	**0.381**	**2.915**	**0.636**	**12.77**	**0.097**	**1.361**	**2.174**	**0.324**	**0.19**	**0.083**

Table 3: LA-ICP-MS data for 4 crystals reportedly from Taraouadji in Niger. Data was collected from 4 spots on each stone. The numbers in blue indicate that the content is below the detection limit (BDL), those in red are below the quantification (BQL) limit of the instrument).

Taraouadji, Niger	**7Li**	**23Na**	**24Mg**	**39K**	**45Sc**	**47Ti**	**51V**	**52Cr**	**55Mn**	**56Fe**	**59Co**	**60Ni**	**66Zn**	**69Ga**	**85Rb**	**133Cs**
TARAOUADJI-NIGER-01 SP1	48.4	527	289	36.24	17.6	10.2	37	48.3	< 1.908	1480	0.43	< 1.361	18.2	9.7	2.38	85.9
SP2	41.4	501	259	36.24	17.3	8.27	33.2	38.4	< 1.908	1450	< .097	< 4.083	15.1	10.4	2.65	83.2
SP3	39.8	491	240	12.08	17.1	11.6	36.3	41.8	< 1.908	1140	< .291	< 4.083	16.9	9.48	1.63	60.3
SP4	41.2	495	271	36.24	14.1	13.4	36.7	49.6	2.03	1460	< .291	< 1.361	14.9	13.5	2.68	62.8
TARAOUADJI-NIGER-02 SP1	74.2	698	354	12.08	16.5	< 7.68	16.9	97	< 1.908	1090	< .097	< 1.361	9.95	7.77	1.24	52.5
SP2	80.3	624	336	12.08	18.9	< 7.68	15	117	< 1.908	1120	< .291	< 1.361	9.99	9.22	1.32	51.8
SP3	63.2	671	358	12.08	18.7	< 7.68	16.4	101	< 1.908	989	< .097	< 1.361	< 6.522	8.88	1.48	47
SP4	58.3	661	318	12.08	17.5	8.09	18.6	109	< 1.908	1020	< .097	< 1.361	< 6.522	8.11	1.75	45
TARAOUADJI-NIGER-03 SP1	36.2	866	401	69	56.6	18.6	135	53.5	4.24	3320	< .291	< 1.361	25.5	25.7	10.1	161
SP2	44.1	860	401	67.3	56.8	12.1	132	33.6	4.32	3270	< .291	< 4.083	22.8	27.3	10.1	151
SP3	46	996	443	75.4	59.1	36.3	114	34.9	5.07	3450	0.62	< 4.083	29.1	23.2	11.7	150
SP4	40.2	843	388	67.1	51.6	13.6	108	38.5	4.19	2790	< .291	< 4.083	23.6	25.5	7.93	95.1
TARAOUADJI-NIGER-04 SP1	47.7	855	428	71.9	59.1	28.5	177	67.9	3.72	3410	0.4	< 4.083	30.6	26.8	9.87	161
SP2	50.3	831	362	69.1	57	26.7	165	68.3	4.81	3680	0.34	< 1.361	17.8	26.7	11.3	152
SP3	42.3	707	341	66.3	50.8	19.6	137	62.7	8.68	2970	0.41	< 1.361	30.5	24.9	10.8	143
SP4	42.5	793	418	64.3	61.1	13.7	163	75.8	4.34	3440	0.34	< 4.083	24.8	23.8	13.3	167
Detection limit (ppmw)	**0.271**	**13.11**	**0.409**	**12.08**	**0.737**	**2.56**	**0.381**	**2.915**	**0.636**	**12.77**	**0.097**	**1.361**	**2.174**	**0.324**	**0.19**	**0.083**

DISCUSSION

This preliminary gemmological study was carried out on samples which were not all collected on the site directly by the authors. If most of the samples from Elmeki were collected directly by SL, the Taraouadji samples on the other hand still require field study to confirm their geographical origin. The samples were nevertheless accompanied by sufficiently credible information to prompt this preliminary study.

The first result is the confirmation that the light green colour of these stones is due to the presence of some traces of chromium. This enables us to describe these stones as emeralds despite their light colour.

The emeralds from Elmeki have a quite different appearance and chemistry compared to the samples from Nigeria provided by Dietmar Schwarz and those from VP reference collection. Emeralds from Elmeki have generally lower lithium (Li) and caesium (Cs) contents and higher rubidium (Rb) levels than those from Nigeria (Figure 17 and Figure 18). The Li-Cs-Rb ternary diagram allows a clear separation between the samples from Elmeki and those from Nigeria (Figure 19). We also note the good separation between the emeralds of Elmeki and those of Colombia or Davdar in China.

On the other hand, the study of the gemmological data (inclusions, spectra, and chemical composition) from the emeralds reportedly from Taraouadji does not enable a separation with the reference stones from Nigeria. In the absence of more reliable samples obtained by the authors, on site, a doubt remains about the very existence of the Taraouadji deposit, especially since a new production of emeralds of similar type has been carried out near Narassawa Egon in neighbouring Nigeria.

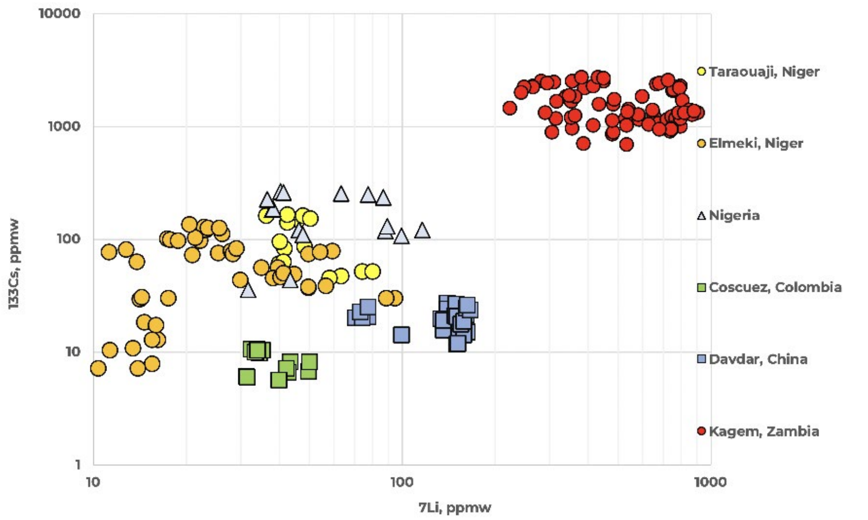

Figure 17: LA-ICP-MS analyses (Li versus Cs) of the studied emeralds from Elmeki and Taraouadji in Niger in comparison with emeralds from Colombia, China, Nigeria and Zambia.

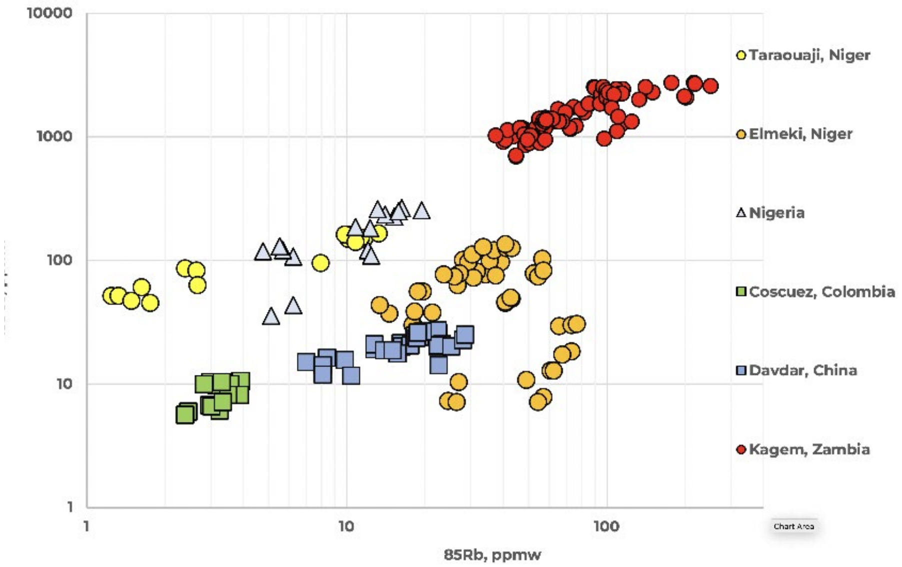

Figure 18: LA-ICP-MS analyses (Rb versus Cs) of the studied emeralds from Elmeki and Taraouadji in Niger in comparison with emeralds from Colombia, China, Nigeria and Zambia.

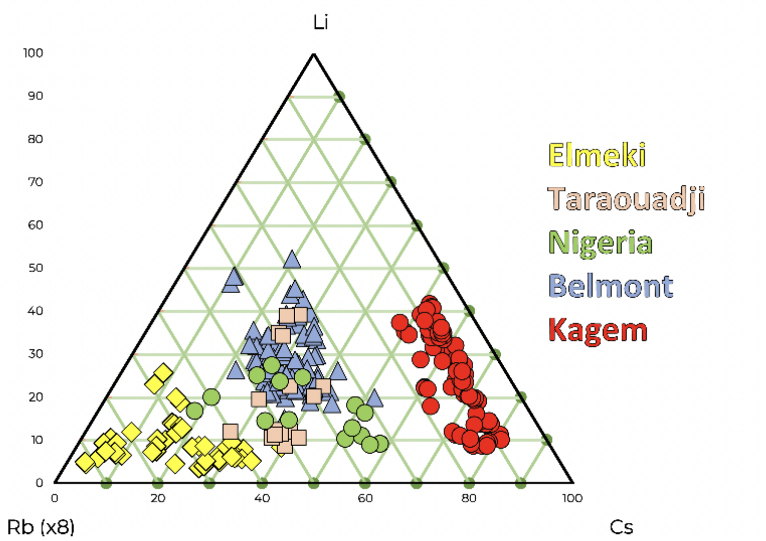

Figure 19: Ternary diagram comparing the lithium, cesium, and rubidium content in emeralds from Elmeki and Taraouadji in Niger with data from Emeralds from Nigeria. The separation between the emeralds of Taraouadji and those of Nigeria is impossible but on the other hand the separation between emeralds from Elmeki and those from Nigeria is very clear.

CONCLUSIONS

The discovery of a new deposit of gemstones is always a source of curiosity, hope and wonder. In this case, the discovery of emerald deposits in the Aïr massif in northern Niger, bordering the Sahara, is particularly exotic. If the existence of the deposit at Taraouadji is confirmed, we would have two interesting new emerald occurrences even if the stones produced in Niger are, so far, not able to compete in terms of color, size and clarity with the gems produced by classic well known deposits.

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