MINERWA – A Interdisciplinary Research Laboratory for Responsible Mining in West Africa

David Baratoux[1], Ernest Kouassi Ahoussi[2], Géraud Magrin[3], Alphonse Yao[4], and the MINERWA team

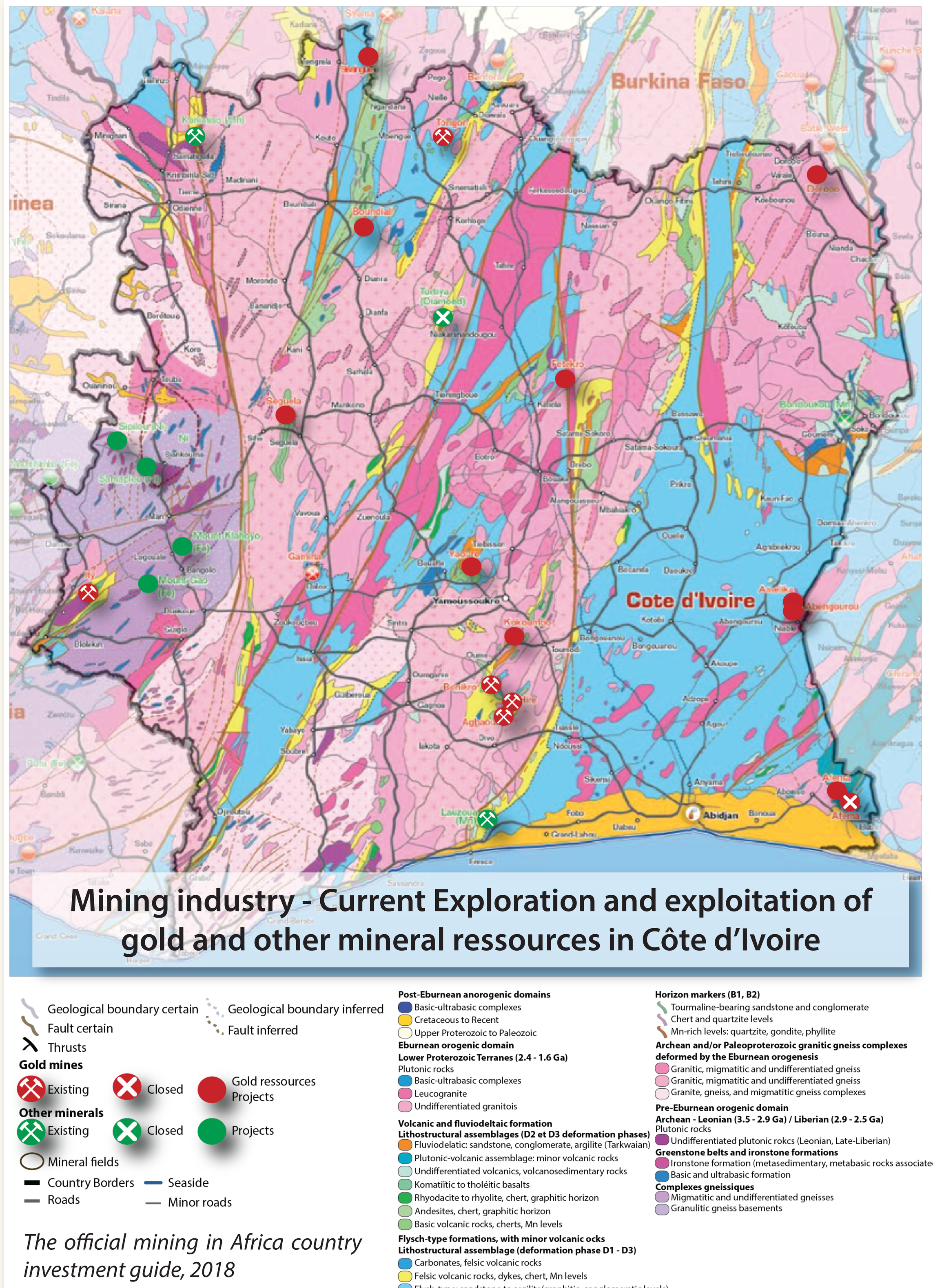
[1]Géosciences Environnement Toulouse, UMR5563, University of Toulouse, CNRS & IRD, 14, Avenue Edouard Belin, 31 400, Toulouse, France. [1]UFR of Earth Sciences and Mineral Resources, University Felix Houphouët Boigny (UFHB), Cocody Abidjan, Côte d'Ivoire. [3]PRODIG Laboratory, University Paris 1 Panthéon-Sorbonne, 2 Rue Valette, F-75005, Paris, France. [4]Institut National Polytechnique Houphouët-Boigny (INP-HB), Ecole Nationale Supérieure de la Géologie (ENSG), African Center of Excellence «Mines and Mining Environnements (ACE-MEM)», Yamoussoukro, Côte d'Ivoire.

https://miner-wa.org

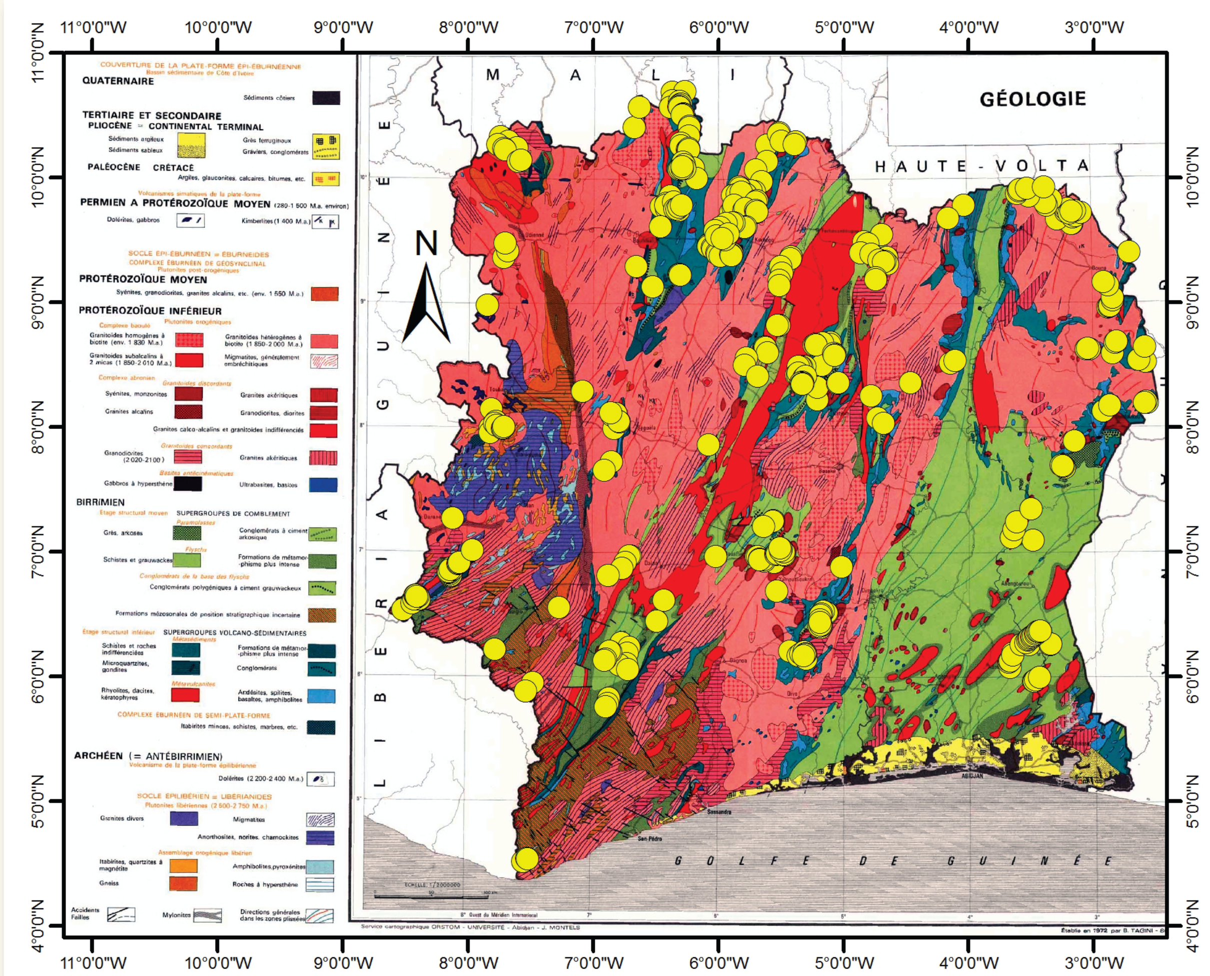
PA41E
1147

Context and objectives

The International Research Laboratory MINERWA (Responsible Mining, West-Africa) has for objective to contribute to the comprehension of the distribution of mineral resources in Ivory Coast, and to their responsible exploration and exploitation, which implies a thorough understanding of environmental and societal impacts.

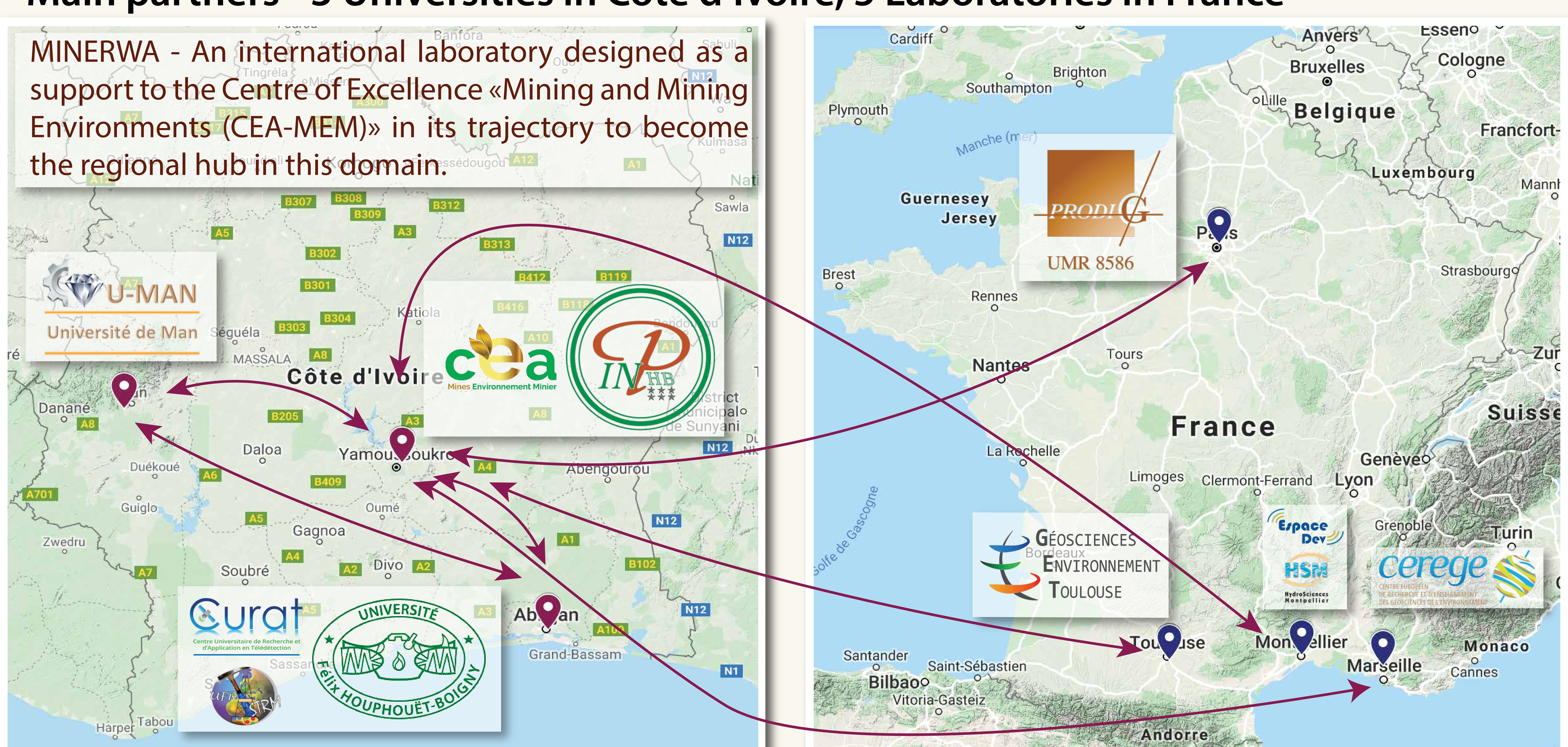


The official mining in Africa country investment guide, 2018



Location of gold panning sites in Côte d'Ivoire, superimposed on the geological map of Côte d'Ivoire. Geological map after Tagini (1972).

Main partners - 3 Universities in Côte d'Ivoire, 5 Laboratories in France



Approach

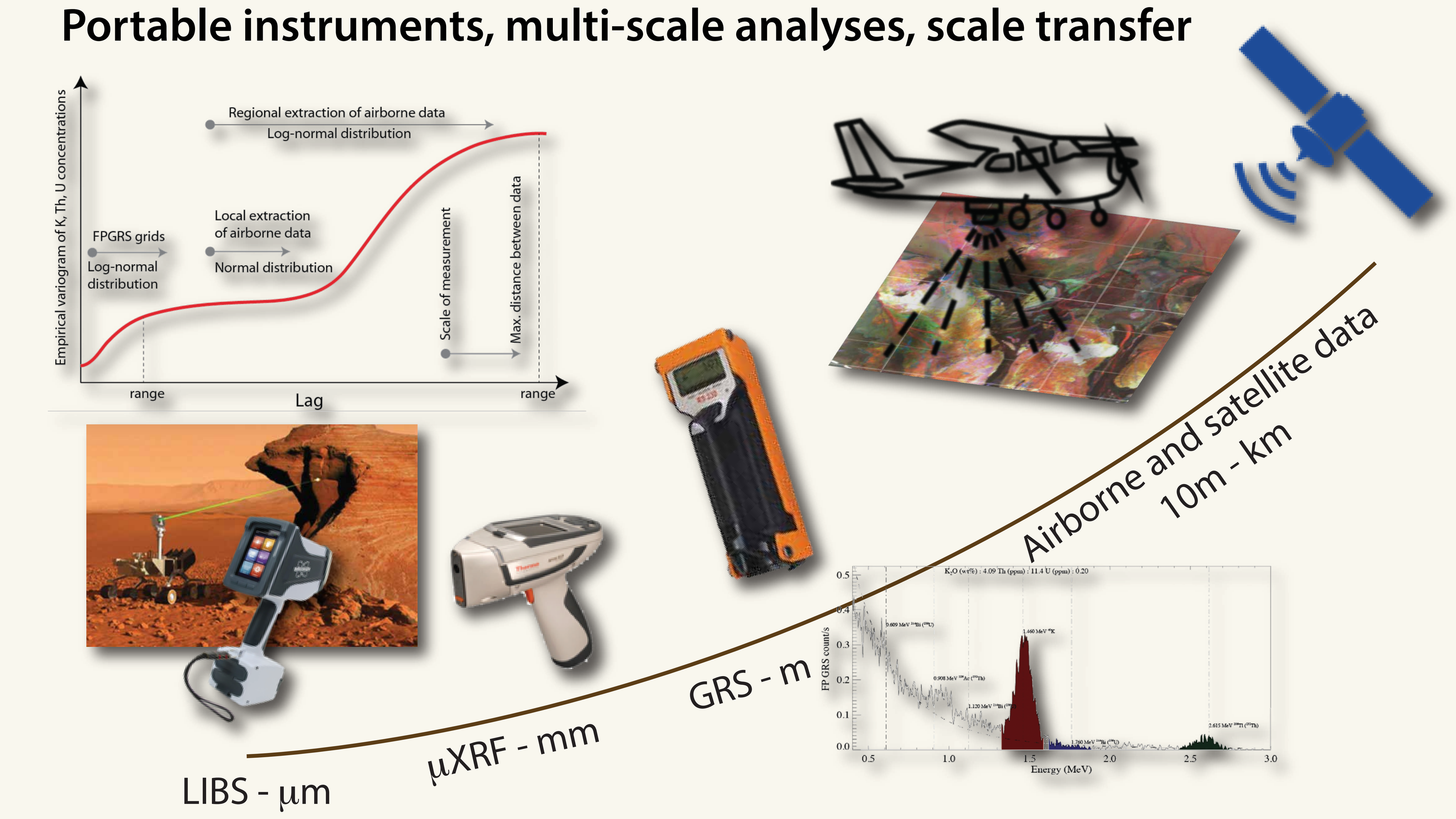
The approach is interdisciplinary and the research team is composed of specialists in social and environmental sciences and geologists. The focus is placed on a multi-scale analysis, from atom/mineral, through territories and to the crust. It also aims to reinforce the analytical capabilities in Côte d'Ivoire, with a focus on free-access remote sensing data and software, low-coast portable instruments and tools for geochemical analysis of rocks and contaminants in the field, including portable XRF, portable LIBS, portable gamma-ray spectrometers and portable visible/NIR spectrometers. The research laboratory shall be funded for 5 years and was initiated in 2019. The activities are divided into 5 workpackages, including (1) a platform for continuous exchanges between the different actors, (2) capacity building, (3) geology of mineral ressources, (4) mines, environment and societies, (5) scale transfer. The first research outcomes will be presented in the session, in particular in relation to the environmental impact of artisanal mining in West Africa (Ahoussi et al., Ngom et al., Saley et al., 2019)

From the atom and mineral to spaceborne observations

Atom/mineral — Territories — Space

Exploration	Mineralogy Geochemistry Metallogeny	Sampling, Structural geology, Petrology, Geomorphology	Airborne geophysics Remote sensing Geomorphology
Monitoring of social and environmental impacts	Geochemistry Pollutants Microbiology	Observations Questionnaires Sampling	High-resolution satellite imagery, time-series
Feasability in the West-African context	Portable instruments (XRF, LIBS, FPGRS, Near-IR/VIS spectroscopy)		Computers Broad band internet Dedicaded access to satellite imagery Open source software

Portable instruments, multi-scale analyses, scale transfer



Activities in 2019

Training and workshops

◆ **Short course on African Metallogeny, CEA-MEM, Yamoussoukro**

◆ **International workshop on abandoned mines, Morocco**

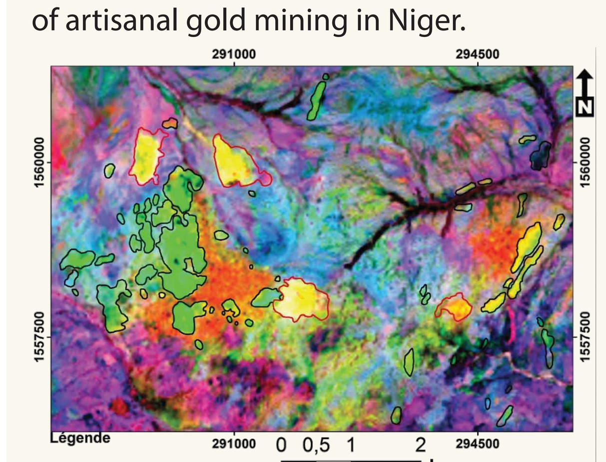
Organized by Moulay Ismaïl, Mohammed V Universities, Ecole Nationale Supérieure des Mines de Rabat, and IRD. With the participation of UCAD, U-Man and EMIG.

◆ **French Alps joint field training between African students and students from the University of Toulouse**

◆ **Google Earth Engine and QGIS training at the CURAT (UFHB Abidjan), with Applied Remote Sensing Lab, UCAD, Dakar.**

Research - example of PhD student projects

◆ **Aboulatif Abass Saley**, EMIG, Niamey, Niger. Environmental impacts of artisanal gold mining in Niger.



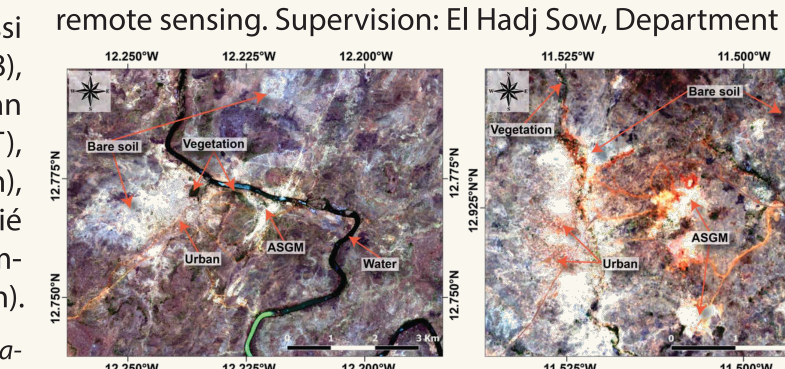
Supervision: Lenka Baratoux (IRD), Kouassi Ernest Ahoussi (UFHB), Alphonse Yao (INP-HB), David Baratoux (IRD), Jean Kan Kouame (UFHB/CURAT), Bamory Kamagaté (U-Man), Gbele Ouattara (INP-HB), Zié Ouattara (U-Man) Gnamba Emmanuel Franck Gouedji (U-Man).

Extraction (black contours) and cyanuration (red contours) areas, Koma Bangou, Niger (Saley et al., 2019)

◆ **Kouassi Serge Aristide Yao,** Doctoral School of the UFR Science of Earth and Mining Resources (UFR STRM, UFHB) (2017 - 2020). Contribution of hydrogeochemistry in the study of hydrosystems near mining sites in Côte d'Ivoire: Case of the department of Divo. Supervision: Ernest Kouassi Ahoussi (UFHB).

◆ **Armand Patrick Yapo**, Doctoral School of the UFR Science of Earth and Mining Resources (UFR STRM, UFHB) (2018 - 2021). Gold panning activities and degradation of hydrological environments in Côte d'Ivoire: Case of the N'zi catchment area. Supervision: Ernest Kouassi Ahsoussi (UFHB).

◆ **Ndeye Marame Ngom**, PCSTUI Doctoral School, UCAD (2016-2019). Monitoring and environmental impacts of mining activity in eastern Senegal: the contribution of remote sensing. Supervision: El Hadj Sow, Department of Geology (UCAD).



Mapping of artisanal mining sites, Eastern Senegal (Ngom et al. 2019)

Collaborations: Lenka Baratoux (IRD), David Baratoux (IRD), Alphonse Yao (INP-HB), Eric Delaitre (IRD) Nadine Dessay (IRD), Gayane Faye (UCAD) Modou Mbaye (UCAD).

◆ **Paul Tonga Tiemoko**, Polytechnic Doctoral School at the CEA-MEM of the INP-HB (2015-2018). Environmental consequences of artisanal mining in Côte d'Ivoire. Supervision: Gbele Ouattara (INP-HB). Collaborations: Ndeye Marame Ngom (UCAD), David Baratoux (IRD), Lenka Baratoux (IRD).

◆ **Farida Boube Dobi,** Polytechnic Doctoral School at the CEA MEM of the INP-HB (2019 - 2021). Evaluation of the impact of gold mining on groundwater dynamics in a context of global changes (Case of Côte d'Ivoire), with the implementation of a hydrogeological model. Supervision: Dr. Eugène Kouakou (INP-HB).

Perspectives (2020) - toward interdisciplinary research

◆ **Visits of Anna Dessertine and Géraud Margin (IRD/PRODIG) in Côte d'Ivoire**

Definition of research perspectives and priorities focusing on small-scale mining : gender issues and women safeties, relationships between plantation agriculture, inequalities generated by the formalization of the activity, environmental degradation, categories of small-scale mines.

Artisanal and small-scale mines in Banjoula, Siguirini in Upper Guinea (Guinea).

◆ **An Interdisciplinary workshop on artisanal and small-scale mining in West Africa - to be organized in 2020 (U-Man / ACE MEM)**

◆ **Perspectives following the audience with the Ministry of Mines and Geology of Côte d'Ivoire (October 2019)**

Role of academic research in the Ministry's actions for the mining sector in Côte d'Ivoire, such as the training of its agents, the geology mapping programme, and regulations of small-scale mining activity.

◆ **Relationships with other networks and projects**

Partners - Networks of African Excellence Center in mining/mining environements (AFD) (Côte d'Ivoire, Niger, Guinea).
AMEDEE - Mining Activity, Environment, Economic Development and Ethics (**https://amedee-network.science**)
EUR TESS - European Doctoral School in Earth and Space Science
West African Exploration Initiative (**www.tectonique.net/waxi3/**)
African Initiative for Planetary and Space Science (**https://africapss.org**)

References - Ahoussi et al. (2019) Assessment of the environmental and socio-economic consequences of abandoned mines in Ivory Cost: The case of the Kokumbo gold mine in the central West part of the Ivory Coast, AGU Fall meeting. Ngom et al. (2019) Mapping Artisanal and Small- scale Gold Mining (ASGM) in Senegal using Sentinel 2 data and Google Earth Engine, AGU fall meeting. Saley, A. (2019) Remote-sensing mapping (Landsat) of abandoned mining wastes over time by artisanal gold mining in Koma Bangou (Liptako, Niger), AGU Fall meeting.

Acknowledgments - This project is funded by IRD - International Laboratory MINERWA and the African Center of Excellence Mines and Mining Environnements (CEA-MEM, INP-HB)