Mapping and Monitoring Artisanal Diamond Mining in Central and Western Africa Using an Integrated Geoscience Approach

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USGS TECHNICAL ASSISTANCE

- The Kimberley Process (KP)
- The Clean Diamond Trade Act of 2003
- The U.S. Department of State’s Special Advisor for Conflict Diamonds
- USAID PRADD Program

Fieldwork at ASM sites in Guinea, 2012

An official KP Certificate accompanying a diamond shipment from CAR
To conduct alluvial diamond resource assessments, an integrated approach has been developed comprised of three essential components:

1. **Geologic and geomorphic data**
   - Grade (carats/m³), gravel thickness, overburden material and thickness, bedrock material, geomorphic zone, etc.

2. **Social and human geographic data**
   - The number of miners, the roles of men, women, and children, tools used, number of days worked per year, seasonality of mining, reasons for mining, etc.

3. **GIS and remote sensing technologies**
   - Used to model the hydrography and geomorphology, identify and characterize pits, and monitor mining activities.
PURPOSE

• It was necessary to develop a methodology for conducting regional and country scale assessments
  • A methodology was first developed by Barthélémy and others (2006) in an assessment of Congo-Brazzaville
  • This methodology has since been modified by Chirico and others (2010, 2012)

• This methodology provides a means of independently verifying a country’s reported diamond production statistics
  • Assessment results are compared to the production statistics released to the KP
  • Areas falling far outside the estimated range are identified as areas of concern

Graph showing alluvial, primary, and total production for Seguela, Côte d’Ivoire from 2006-2012
Chart showing production for Seguela and Tortiya, Côte d’Ivoire, from 2006-2012
FIELD WORK

Collection of social and human geographic data through group interviews

Comprehensive questionnaire used for data collection
Site characterization: Collection of geologic and geomorphic data through measurement, sampling, and observation

A researcher collecting data in Guinea

Artisanal mine pit with profile, Heremakono, Guinea

Artisanal mine pit with profile, Fondiya, Guinea
GEOMORPHIC MODELING

- Deposit richness is closely related to local geomorphology
- A model is developed for the study area characterizing the geomorphic units
PRELIMINARY SATELLITE IMAGERY ANALYSIS

Satellite imagery can be used to identify active vs. inactive mine sites, thus providing information on the level of activity and identifying locations for field visits.

Changes at a site over time, Bouramaya, Guinea

New mining by artisans

Fieldwork
03/06/2012
[A] Active mine sites interpreted from satellite imagery and represented by diameter  [B] Area of detail showing active mine sites (circled areas) and currently inactive, previously mined pits (pits with dark reflectance).
TIME SERIES ANALYSIS OF ACTIVE PITS IN THE SEGUELA REGION, COTE D’IVOIRE

Graph showing alluvial, primary, and total production for Seguela, Côte d’Ivoire from 2006-2012
CAR Monitoring: Sam Ouandja terrace mining and washing site

Mining camp expands to large site measuring 265 m x 110 m. Over 100 active pits identified.

Jan. 29, 2013

Mining camp expands to site measuring 180 m x 95 m. Over 65 active pits identified.

Dec. 26, 2012

New mining camp established


Continued mining activity and expansion. Increased gravel washing along river to the north of site.

April 29, 2013

2006
UFDR formed
Bira, Ndele, Sam Ouandja, Ouadda attacked by UFDR

2008
Libreville Comprehensive Agreement signed between rebel groups (ARPD, UFDR, FDPC, CPJP) and Bozizé’s government

2012
Sept.
Seleka CPSK-CPJP-UFDR coalition formed

Nov.
Dec.
Sam Ouandja, Ouadda, Ndele, Bria seized by Seleka, in addition to 5 other towns
Peace agreement signed in Libreville between Seleka and Bozizé’s government

2013
Jan.
March
Seleka breaks agreement and seizes 7 towns, reaching Bangui on March 23
TECHNICAL ASSISTANCE WORKSHOPS AND TRAININGS

• As a component of the technical assistance plan, the USGS has conducted workshops and trainings in CAR, Mali, Ghana, and Guinea.

• Trainings typically include:
  • Hands-on practical field methods training
  • GPS training
  • Basic GIS skills training
  • Remote sensing imagery applications training
  • The transfer of laptop computers, GPS units, and/or GIS software to the Mining Ministry
  • A summary presentation of the results of the assessment
SCIENCE APPLICATIONS

• The USGS Special Geologic Studies Project has conducted resource assessments of other minerals, including placer gold deposits in Afghanistan.

• Other potential applications include:
  • The assessment of tin, tantalum, and tungsten deposits in the Democratic Republic of the Congo
  • Burmese rubies and jade

• The data collected to complete these assessments have a wide range of applications, due to its diverse nature, including:
  • Human health (the use of mercury in gold mining)
  • Gender roles (the unique roles of men and women at mine sites)
  • Human migration (the movement of people from site to site)
Central African Republic:

Mali:

Ghana:

Guinea:

Côte d’Ivoire:


