**CSCC** Centro di ricerca sulle Scienze Cognitive e la Comunicazione
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## GOLDATA
## The Gold deposit dataset Codebook

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## Abstract

Empirical observation of recent civil conflict events suggests a correlation between gold exploitation, conflict dynamics and military financing. Conflict literature recognizes a prominent role to gold as it holds many characteristics that make it a lootable and profitable resource for any belligerent group which is able to collect revenues from its exploitation. Gold, indeed, has a high economic value; it is an accessible and diffuse resource which makes it more difficult to be controlled by government forces. Despite such evidence, the potential influence of gold exploitation on armed civil conflicts has not been empirically investigated in a proper way. GOLDATA is an original geo-referenced dataset on gold occurrences which has been designed in order to enrich spatial analysis about the role of natural resources on conflict events and dynamics. GOLDATA provides a comprehensive list of gold occurrences complete of geographic coordinates, discovery and production dates which can be displayed and analysed through geographic information systems (GIS) tools.

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**Introduction**

Throughout the ages, gold has been highly valued by peoples who possessed it because of its scarcity, durability, aesthetic value, and its characteristics such as being essentially imperishable and easily worked. It was first recovered from streambed gravels, where it occurs in metallic form, not requiring complex extraction techniques. Gold has maintained its importance and it is still a significant store of economic value. Besides its widespread monetary and symbolic functions, gold has nowadays many practical uses in dentistry, telecommunications, electronics, and other fields due to its high malleability, ductility and resistance to corrosion. Thus gold market still represents a notable source of potential profit.

Empirical observation of recent conflict events suggests a correlation between military activities and – often illegal – gold exploitation and sale. It is worth mentioning some examples such as the Democratic Republic of Congo where alluvial gold of the South Kivu province sustained Laurent Kabila's rebel movement, or from Asia, such as Malaysia.

Beyond high economic value, gold holds many characteristics that make it a lootable and profitable resource for belligerents since it may be an accessible – especially in its alluvial and placer forms – and diffuse resource which makes it more difficult to be controlled by government forces. In other words, it may constitute a profitable resource to be easily collected and traded during wartime.

Despite such observed correlation, gold exploitation influence on armed conflicts has not been empirically analysed in a proper way. For such reason, this project aims to introduce on conflict literature an original geo-referenced dataset on gold resource locations which can be used as research instrument in expanding the analysis about the role of natural resources on conflict dynamics. Although the original aim is the contribution to conflict literature, GOLDATA should be used in a broader range of studies where geo-referenced data on natural resources are applied.

The author coded GOLDATA with a structure compatible and consistent with other PRIO/CSCW Datasets on natural resources – namely Diadata (Gilmore et al., 2005), Gemdata (Flöter et al., 2003), Petrodata (Lujala et al., 2007) - extensively applied in conflict literature. This operational choice in GOLDATA designing responds to the need of standard and interchangeable tools in conflict analysis in order to provide reliable and comparable empirical evidence and, thus, consistent policy advices.

The dataset is available as spreadsheet (Excel) format.

GOLDATA originates from the background work carried out during the elaboration of the dissertation for the MSc in Development Economics, at University of Sussex. Whilst exploring the role of natural resources on conflict dynamics, indeed, the author identified a lack of comparable and accessible tools storing geo-referenced data on the natural resources commonly recognized as "conflict resource" by empirical observation. In particular, although gold exploitation has fuelled several conflict events, a comprehensive dataset on gold deposits, location and characteristics was not available. Consequently, the author elaborated GOLDATA in order to full fill such gap, collecting spatial information on gold deposits as relevant features to armed conflict research. Thus, GOLDATA is an outcome of the research activities carried out within the PhD programme in "Instituzioni e Politiche" at the Università

Cattolica of Milan. GOLDATA has been firstly introduced and applied in the PhD thesis Balestri S., (2012) *"Natural Resources and civil conflict intensity: evidence from a spatially disaggregated analysis"*.

## 1. Description of the dataset

This section introduces both the original and compact version of GOLDATA. That dataset is a comprehensive list of gold occurrences complete of geographic coordinates, discovery and production dates and it has been designed to be displayed and analysed through geographic information systems (GIS). The dataset shows up as an attribute table which can allow a broad use of the information provided in analysing different effects of gold resource endowments.

Considering the main purpose of this research, countries such as Australia, Canada and United States have not been included in the GOLDATA dataset, even if they are relevant gold producers. These countries, indeed, have never experimented conflict events since 1946 and their coding would have enlarged several times the dataset size with no additional useful information for the purposes and structure of this research.

For a complete list of the countries coded, see Annex A.



*Fig.1 Graphical map of gold occurrences coded in GOLDATA*

GOLDATA covers data on gold deposits once recognized as *i)* Occurrence deposit, *ii)* Prospect project or *iii)* Producer deposit. The first category, 'Occurrence', refers to a concentration of gold that is considered valuable by someone somewhere, or that is of

scientific or technical interest. It should be of a sufficient size and grade that it might, under the most favourable of the circumstances, be considered to have economic potential. The second category, 'Prospect', refers to a deposit where preliminary exploration and/or first exploitation activities have been carried out. Finally, the third category, 'Producer' refers to active deposits where exploitation is systematic at the time of data entry. In other words, the dataset codes any site with confirmed discovery, any known activity, regular and/or significant production (either commercial or artisan).

The complete list of sites was defined through an extensive literature research of geological databases, academic resources, national geological survey reports and private sector reports. Meanwhile, the geographic coordinates assigned to each site were collected from reliable sources as exact data, or checked in resource maps or, lastly, associated to the nearest landmark.

The dataset is structured to provide time information for each site indicating the discovery year and the first production year. As every conflict, indeed, a mining activity shows specific space and time characteristics, thus both components were introduced in the dataset. Conversely, the last year of production is not reported in the final version of GOLDATA since production closure might be highly connected to contingent industry requirements and be endogenous to conflict occurrence within a country.

Finally, beyond the extended version of GOLDATA, the author generated a compact version in order to reduce the number of records with missing discovery and production dates. In the compact version gold occurrences are selected into sub-sets sort by deposit and operation type, and spatially aggregated if deposits lie within 50 Km.  In that way, the occurrences are grouped into multipoints sharing the same attributes, thus filling several missing data and reducing the number of records with lack of temporal information.


## 2. Construction process of GOLDATA

### a. Definition of gold occurrence

Consistently to the purposes of GOLDATA, the definition of gold occurrence refers to any gold deposit site with known activity. An exploitation activity is defined, within this framework, as any organized mining activity (such as industrial or commercial mining); small scale mining activity (such as artisan mining); exploration on concessions with confirmed gold occurrence; approved concessions by host government for prospecting and exploration activities with confirmed gold presence.

In such sense, the inclusion criterion used results in a quite broad definition finalized to capture any kind of gold exploitation activity, as far as possible. It is worth noting that, to date, clear guidelines about natural resources classification in relation to the study of armed conflicts - as potential mean of incentives and opportunities for belligerents – are still missing (Gilmore et al., 2005).

GOLDATA consists of 3051 entries for gold occurrences in 110 countries. Among them, 98 countries report at least one active production, while the remaining countries have been included due to active exploration activities carried out on known deposits or past production

activities within the period 1946-2010. A production with active status refers to a still on-going production and, at the same time, known in its first year of activity.

### b. Data collection and information sources

In order to collect detailed and consistent data on gold deposits' locations and the associated information, such as discovery date or operation type, several sources have been consulted including an extensive literature research of geological databases, academic resources, national geological survey reports and private sector reports.

The primary source of information explored for the elaboration of GOLDATA is the Mineral Resource Data System (MRDS) managed by the US Geological Survey (USGS). The MRDS provides an extensive list of mineral resources complete of geographical coordinates and descriptive information – such as deposit name, deposit characteristics and production - about mineral commodities throughout the world. It consists of almost 112,000 records on metallic and non-metallic mineral resources. All the entries for gold resource have been drawn out, analysed and verified[1].

Secondly, Geo-Ref database, established by the American Geological Institute, represents the second source of information. GeoRef provides mineral information and geo-science literature – journal articles, books, maps and reports - since 1933[2].

The third major spatial database used in data collection is InfoMine (2005), which is commercial database containing information on mineral properties and their geographic coordinates. For GOLDATA elaboration 456 records are drawn from InfoMine[3].

All the information obtained from the three mentioned databases are verified and supplemented with the Mineral Yearbook contents, annually issued by the US Geological Survey (USGS)[4].

In addition, the institutional reports - issued by the Ministries responsible for the mining sector within the countries encoded in the dataset - were consulted and they represent a good source of information. In many cases, these documents are directly available from the institutional web-sites, in other cases they were requested to the corresponding technical offices.

The institutional web-sites of many private extractive companies were also consulted. The annual reports and the description of on-going exploration projects, indeed, may provide several information on previous exploitation activities in a specific area, as well as data on past deposits' names and, sometimes, geographic coordinates.

Finally, a significant amount of information was culled from the web.

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[1] The Mineral Resource Data System is available at http://tin.er.usgs.gov/mrds/. Data research can be filtered by country or commodity. Data provided by USGS cover only countries where the institution is active and they are primary focused on America. This is partially reflected on the records collected in GOLDATA where deposits in Latin America, for example, are extensively encoded.

[2] GeoRef information is available at www.georef.org.

[3] InfoMine is available at www.infomine.com

[4] The Mineral Yearbook is an annually published report on mineral occurrences around the world organized by country or region of observation. It is available at http://minerals.usgs.gov/minerals/pubs/country/index.html#pubs

In GOLDATA, for each observation recorded, all the sources listed above were consulted and compared each other. Not all the records found were introduced in GOLDATA dataset since, in many cases, overlaps and contradictory definitions or locations have been detected. As a result of this analysis, a list of locations was compiled and, thus, the geographic coordinates were assigned to the records.

When it was not possible to find geo-referenced data on a gold occurrence, the geographic coordinates were assigned on the basis of a landmark (for example, nearby village, lake and mountain) and other descriptive information. Lastly, in case of not unique geographic names or missing coordinates, the Geographic Names Information System (GNIS), established by the US Geological Survey, was explored in order to identify geographic locations and landmarks[5].

### c. Time dimension

Whereas collecting a time series for all production sites would have been highly desirable, this effort has been hampered by a lack of temporal information. As already mentioned, only a minor part of records show discovery and production dates, even if an extensive research on time dimension of the deposits activities has been carried out.

The production period is encoded regardless whether the production was continuous or intermittent since the starting time. This aspect leads to consider information on a site production stage as static more than temporal. The decision to organize in that way the dataset was driven by practical considerations about the difficulties found in coding discovery and first production dates.

As already mentioned, the last year of production is not included in the dataset. This choice is led by several reasons, including the scarce availability of such information and the potential misleading interpretation of this data. The production closure of organized and commercial exploitation, indeed, either permanent or temporary, should be not necessarily reflected in the end of all exploitation activities. In particular, artisanal exploitation - even with sizeable amounts of exploited minerals – might continue, leaking from official records. For example, small-scale or artisanal activities at reduced levels might continue as operated by third subjects once the main site structure is fully defined and the deposit characteristics allow the adoption of easily manageable exploitation techniques.

Finally, a general interpretability concern has been also taken into account. For example, it may be the case that organized commercial gold production would been temporarily stopped due to an occurring conflict, making such momentary production end date endogenous to the main variable of interest – civil conflict occurrence – in this research project.

Concluding, the dataset is organized to provide information on gold locations, to highlight the date since they were known – and so they may represent a potential source of profit - and, as far as possible, since they became actually profitable. In consideration of the purposes of this research, this aspect is what matters.

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[5] Data from the Geographic Names Information System are available at http://earth- info.nga.mil/gns/html/namefiles.htm.

### d. Data reliability

As far as concern data reliability, collecting data on precious metal deposits involves issues of lack of transparency and trustworthiness that are not easy to overcome. In the elaboration of this dataset, all attempts have been made to provide a comprehensive and reliable list of gold occurrences complete of geographic coordinates. However, despite this aim, the dataset might suffer from different sources of biases. Some biases and omissions may be due to lack of information and records; falsification – intentional or unintentional – of the records; country's unwillingness to disclose and make public the recorded data.

Collecting comprehensive data on mineral endowments and mining activities represents a major challenge for several developing countries, which usually face with substantial shortage of technologies and human capital, beyond a lack of transparency. Such task is particularly burdensome when a country has experimented a prolonged period of instability and conflict. In the case of gold resource, for example, many sub-Saharan African countries, such as Chad, Central African Republic, Lesotho, Togo, are expected to possess considerable reserves, however such deposits are still not properly localized and artisanal or small-scale mining is still the major extracting activity. In addition, in case of lengthened local instability, affected areas become even more difficult to map.

In other cases some countries do not intentionally release complete information about their mineral potential and production. For example, data on extractive locations in China or Russia, two of the most important gold producers in the world, are sometimes roughly approximations. Language translation represents also an issue and it may affect the records: not all the existing documents, indeed, are available into international conventional languages.

In countries where mining companies are not established, data collection on gold occurrences is often highly complex. Many countries, in particular in sub-Saharan Africa, are not able to finance and manage comprehensive geological mapping, thus the role of private sector could be significantly relevant in overcoming these difficulties and reducing the lack of detailed information. Conversely, sometimes private companies not always respect a minimum standard of transparency once not imposed, especially if they are operating in host countries with weak legislation on that issue, and they do not allow spreading information on gold extracting activities.

Furthermore, artisanal and small-scale mining – difficult to be recorded by definition – is a common feature in all gold producer countries, especially where alluvial gold is available. The dimension of artisanal and small-scale gold mining and the lack of localized data become more relevant in contexts where, as mentioned above, public records are not available. The whole exploitation figure, indeed, may not properly appear.

Finally, illegal exploitation and illicit trade through international borders as well as falsification of records are particularly relevant facts in several countries. Probably, the most appropriate example can be provided by the Democratic Republic of Congo. In this case, indeed, the official production figures are highly misleading on the true level of domestic production, since a considerable percentage of extracted minerals reach international markets through Ugandan and Rwandan exports. Moreover, some high productive regions like the Kivu and the Oriental Region, are torn by decades of civil conflict which, in turn, has been sustained by mineral exploitation within the area.

Despite such problems, generally definable as due to a – intended or unintended – lack of information, it is necessary to consider that many deposits are not well defined and their location on a map are sometimes approximates or related to the nearest landmark.

It is worth noting also that, since the information collected in this dataset comes from several sources, some gold occurrences may result from the joint consideration of adjacent locations or may be input as a unique entry of multiple locations with same geographic coordinates but different site names. In these cases, aggregated information on original locations is provided in a separate field.

## 3. GOLDATA structure: data description and variables generation

GOLDATA dataset consists of 18 different attributes coded for each observation recorded. In this section, data and attributes are described.

Table 1 synthetically shows the dataset structure providing information on the variable definitions and format used for each attribute. In particular, the dataset provides the following information:

- Primary Key (PRIMKEY)

Each record is encoded by a unique primary key which allows users to clearly identify it. This variable is composed by three elements for each entry: the FIPS country code, the deposit number and the resource codification. For example, in the dataset the first observation (001) of gold deposit (AU) is located in Albania (AL) and it is encoded with primary key AL001AU.

- Country Name (COUNTRY)

The country where the gold deposit lies (at the present time) is coded as assigned country. The dataset contains 110 countries (See Appendix A for the complete list of countries). In case of country characterized by modified geographical extent or name or status (e.g. due to independence or a regime collapse) over time, some data manipulation has been required.

- FIPS Code (FIPSCODE)

The dataset distinguishes countries applying the corresponding FIPS code (Federal Information Processing Standard). This inclusion is aimed at facilitating the analytical use as well as the manipulation and comparison activities through different geo-referenced tools, for example, ESRI products.

- COW code (COWCODE)

Following PRIO/Uppsala Armed Conflict Dataset codification rules and other go-referenced natural resources datasets, the host country is also coded by the corresponding COW numbers (Correlates of War) in order to guarantee compatibility of use. Analogously, a '-9999' code describes any country without a COW number, for example Overseas French Departments such as French Guiana.

*Table 1*        *GOLDATA: variable definitions and coding structure*

| No. | Variable Name | Label | Description | Format |
|-----|---------------|-------|-------------|--------|
| 1 | PRIMKEY | Primary Key | Unique identifier for each observation | String |
| 2 | COUNTRY | Country of deposit location | Name of the country where the deposit is located | String |
| 3 | FIPS CODE | FIPS code for deposit location | FIPS abbreviation for country | String |
| 4 | COW CODE | COW code number for deposit location | COW country number code | Number (integer) |
| 5 | CONT | Continent of deposit location | Continent corresponding to the geographically defined COW country number code | Number (integer) |
| 6 | SITENUM | Number of deposit | The unique identifier number for each site by country | Number (integer) |
| 7 | NAME | Name of deposit | Either the name of the mine or the name of nearest major landmark | String |
| 8 | LAT | Latitude of deposit location | First component of the geographic location in decimal degrees | Number (three decimal places) |
| 9 | LONG | Longitude of deposit location | Second component of the geographic location in decimal degrees | Number (three decimal places) |
| 10 | MINEINFO | Mine status | Mining activity status | String |
| 11 | AUINFO | Deposit gold intensity | Proportion of gold present in the site | String |
| 12 | RESINFO | Deposit characteristics | Description of deposit type | String |
| 13 | OPERINFO | Operation type | Description of extractive operation type | String |
| 14 | SITEINFO | Other deposit characteristics | Additional information on deposit characteristics | String |
| 15 | DISCyear | Discovery date | Date when the resource deposit was discovered | Date (yyyy) |
| 16 | DISCyear_prc | Discovery date precision | Precision coding for discovery date | Number (integer) |
| 17 | PRODyear | Starting production date | First confirmed production activity | Date (yyyy) |
| 18 | PRODyear_prc | Starting production date precision | Precision coding for the starting production date | Number (integer) |

- Continent (CONT)

Each country in the dataset holds also information about the Continent of belonging. The assignment is carried out applying the PRIO/Uppsala Conflict Dataset definitions in order to guarantee compatibility of use. Thus:

1. Europe: Geographic definition, including the states in the Caucasus, COW numbers between 200 and 395;

2. Middle East: Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Syria, Turkey, and the states of the Arabian Peninsula, COW numbers between 630 and 698;

3. Asia: Geographic definition, including Oceania, Australia, and New Zealand, and excluding states in the Middle East, COW numbers between 700 and 990;

4. Africa: Geographic definition, excluding states in the Middle East, as listed above, COW numbers between 400 and 625;

5. Americas: Geographic definition, including states in the Caribbean, COW numbers between 2 and 165.

All countries not compliant with these definitions hold continent codes as displayed by US Geological Survey (USGS).

- Deposit Number (SITENUM)

A deposit (site) number is assigned to each observation and it is used for identification purposes as part of the primary key.

- Deposit Name (NAME)

The deposit (site) name is the official name of the gold occurrence. It is not a definitive identification name, since gold deposits might receive different names throughout periods and, sometimes, the site name is connected to significant landmarks used to define the mineral location. Cultural elements, such as language, customs and traditional knowledge, may contribute in modifying such names. In case that the deposit name represents an aggregation of contiguous sites, SITEINFO reports the original deposits' names. This information, however, is not always cross-referenced and it is included only for known cases elaborated by the author.

- Latitude (LAT) and Longitude (LONG)

This dataset is aimed at providing information on geographic location of gold occurrences, thus, specific geographic coordinates define each gold occurrence encoded. Latitude and longitude are expressed by decimal degrees on 360° scale and southern latitudes and western longitudes are identifiable by negative values. The coordinates are expressed with three decimal points.

Every effort has been made to collect accurate coordinates; however, such precision is variable among records since geographic information derives from multiple sources and it may eventually refer to the nearest landmark.

Geographic coordinates, indeed, might have been *i)* found directly in a reliable source, *ii)* derived from a map complete of clear or unclear geographic coordinates and, finally, *iii)* estimated as a known distance from a landmark.

- Resource code (RES)

The Mineral Resource Data System (MRDS), as the major information source for data collection, is used as reference point for the resource code. Following MRDS coding system, the code applied for gold is AU.

- Information on Mine activity (MINEINFO)

This field provides information whether any extractive and production activity has occurred in any given deposit. It may assume four different labels indicating specific time stages: *i)* Occurrence, *ii)* Prospect, *iii)* Producer and *iv)* Past Producer.

An Occurrence refers to an ore mineralization in outcrop, shallow pits or isolated drill hole (Mineral Resource Data System, 2012). In that stage, no production or significant activity has taken place since discovery, with the possible exception of routine claim maintenance. However, it refers to a gold known deposit, although not quantitative defined in grade and tonnage.

The Prospect development status represents a subsequent stage to the Occurrence stage. It refers to a deposit where preliminary exploration and/or exploitation activities - as surface trenching, adits or shafts, drill holes, extensive geophysics, geochemistry, and/or geologic mapping, have been carried out (Mineral Resource Data System, 2012). These activities are generally sufficient to determine the deposit grade and tonnage. The deposits may or may not have undergone feasibility studies that would lead to a decision on going into production.

A Producer deposit refers to a mine which is in production at the time the data is entered. An intermittent producer that produces on demand or seasonally with variable periods of inactivity is still considered a Producer.

Finally, a Past Producer development status refers to a mine formerly operating that was closed, thus, where the exploitation and logistic equipments or structures may have been removed or abandoned at the time the data is entered.

During the elaboration of this dataset, a relevant effort has been dedicated in collecting as much data as possible to determine the development status of the encoded deposits. However, despite such attempt, funding reliable information has not always been possible. In case of insufficient data regarding mine production status, the label "Unknown" is encoded.

Finally, no data on size production is introduced since that field would have only qualitative information which should not be over interpreted because of its pure descriptive nature (Gilmore et al., 2005). Moreover, in almost all cases, this information was difficult to obtain, and very often it was hardly interpretable due to inconsistency and not unique definitions. In order to avoid misleading data and in consideration of the purposes of this research, it was considered more useful identifying as far as possible the development status of the deposits rather than not reliable production size. In other words, assessing the opportunity to access to valuable resources during conflict events is the core point to be taken into consideration.

- Resource Information (AUINFO)

Gold deposits may change a lot in grade, tonnage, geological formation. Since size information are not provided in quantitative data (as explained later at 'Information on Mine activity' paragraph), deposits are divided into three categories in order to give information on the relevance of the gold amount contained. More specifically, in this field gold is coded as *i)* Primary commodity (P); *ii)* Secondary commodity (S) or *iii)* just as Trace (T) on the base of the prevailing composition of the deposit.

- Deposit Type (RESINFO)

This field provides information on the deposit typology; in particular, it defines each gold occurrence as *i)* Placer or *ii)* Vein. In case of no reliable information about deposit type, this field shows up as blank entry.

A Placer deposit refers to an alluvial, eluvial or residual deposit containing particles of gold: it may be mined by an open-pit or by various surface excavating and filtering techniques. In terms of accessibility and resource exploitation techniques, this type of deposit probably represents the easier source of gold during wartime. Alluvial gold is a specific case of a placer deposit and it is usually found in sand, clay, gravel, or other matter deposited by flowing water, as in a riverbed, floodplain or delta. The RESINFO field shows the definition "Alluvial", when appropriate.

A Vein deposit refers to a geological occurrence - which includes many different geological typologies, such as mesothermal veins – constituted by a body of crystallized minerals, in this case gold, within a rock. The majority of gold deposits are found in such type of geological formations, which could be identified at different soil depths.

In relation to the study of civil conflicts, it should be remembered that lootable and easily accessible mineral resources seem to be highly attractive for belligerents during conflict events. For this reason, GOLDATA allows users to identify deposit type and exploitation characteristics in order to define the lootability of each deposit. The compact version, as later described, distinguishes gold deposits between lootable and not-lootable deposits.

- Operation Type (OPERINFO)

Intuitively, the characteristics of each gold deposit (typology) might influence how gold exploitation can be carried out, shaping the extractive operation type. In this field, information on the mining operation type are provided as: *i)* Underground; *ii)* Surface or *iii)* Surface/Underground.

An Underground exploitation occurs when the mine opening is small relative to the workings size. The access to the mine is usually called shaft or adit. The ore is trucked from the mine in cars, buckets, on convey or belts.

A Surface exploitation occurs when the overburden is completely removed and the sides of the mine are typically terraced away from the centre (such as open-pit mine). The overburden and ore are usually carried out from the pit in trucks. The same definition is also use in case of superficial exploitation activities such in case of stream-sediment or beach-sand mines.

A Surface/Underground exploitation occurs when both surface and underground operations are simultaneously present.

In case of no information on the operation type the Unknown label is entered.

- Discovery Date (DISCyear)

Discovery date refers to the first confirmed occurrence of the resource in any given deposit. GOLDATA is designed in order to be applied in the analysis of civil conflict events occurred since 1946 to date. In many cases, particularly in Latin America, the discovery date refers to period well prior to the reference time threshold. For this reason, the complete version of

GOLDATA reports discovery dates as identified in order to provide a comprehensive information, whereas the compact version, in case that the discovery date was preceding the reference period (1946-to date), reports the "1946" value.

- Discovery Precision (DISCyear_prec)

Collecting data on time dimension of mining activities has been challenging. The temporal unit commonly collectable is a reference year and, consequently, GOLDATA basically provides temporal information through the indication of discovery year. No information on month and day of discovery are provided. Analogously to other similar geo-referenced datasets (Gilmore et al., 2005; Lujala et al., 2007), the following coding scheme is applied to differentiate the recorded cases:

1. Year is precisely coded, even if day and month are unknown.

2. Not unique information on discovery year is found in different sources. The discovery year is then assigned as subjective judgement from the available information.

3. Discovery year is unknown and no information on date is available. In GOLDATA complete version it corresponds to a blank entry for discovery date, in the compact version to 9999 enter.

Such scheme is applied for the first production date precision also.

- Production date (PRODyear)

The production date refers to the first artisanal or commercial production recorded. Applying the same logic as before, for all sites where production began prior to 1946, in GOLDATA compact version, the production year is coded as 1946. No available information on the starting production date is shown as a blank entry.

- Production date precision (PRODyear_prec)

For this field, refer to the scheme applied for discovery date precision.


4. **GOLDATA compact version**

The compact version of GOLDATA is elaborated through the use of MapInfo Professional 11.0. The compact version is the outcome of a simplification process applied in order to generate a more complete dataset.

The aggregation procedure unifies all attributes for gold deposits which lie within 50 km, and it creates in that way multi-points, sharing the same attributes. In other words, in case of spatial aggregation the discovery date for a multi-point is assigned based on the earliest discovery date among the sites within the group. In this way, the number of gold deposits without temporal information is significantly reduced.

### a. Construction stages of GOLDATA compact version

The first step of the aggregation procedure was the definition of different sub-sets. Indeed, six sub-sets of interest are generated and they are independently accessible. In particular, GOLDATA compact version is structured as follows:

**"GOLDATA_L"** sub-set:
It contains placer deposits (including alluvial deposits) which are recognized by conflict literature as lootable, due to basic exploitation activities required to extract gold resource;
**"GOLDATA_Lprod"** sub-set:
It contains the placer deposits identified in "GOLDATA_L" whether complete of known production date;
**"GOLDATA_S"** sub-set:
It contains gold deposits characterized by surface operations, but with no information on deposit type. Such deposits do not hold enough information to be properly defined as lootable, however it is not possible to exclude *a priori* the possibility they might be lootable (due to missing information on deposit type);
**"GOLDATA_Sprod"** sub-set:
It contains the gold deposits identified in "GOLDATA_S" whether complete of known production date;
**"GOLDATA_NL"** sub-set:
It contains vein gold deposits which are recognized by conflict literature as hardly lootable, due to complex exploitation activity and/or investments required to extract gold resource. All sites with unknown characteristics for deposit type are here included as non-lootable resource deposits, if not characterized by surface operations type;
**"GOLDATA_NLprod"** sub-set:
It contains the gold deposits identified in "GOLDATA_NL" whether complete of known production date.

The complete GOLDATA version contains 3051 records: 321 records, corresponding to 580 gold deposits, hold to the lootable category, 324 records, corresponding to 416 deposits, represent gold deposits with surface exploitation activities with no information on deposit type, and, finally, 988 records, corresponding to 2055 gold deposits, hold to the non-lootable category.

The "Surface" category was introduced in the elaboration of the compact version since it includes records characterized by superficial operations (which may be easily exploitable or controllable by belligerents during a conflict), nevertheless the lack of information on the deposit type makes not possible to define them with total certainty as placer deposits (the more lootable). It is argued that as regards conflict analysis it would be questionable to not consider such deposits as potentially exploitable during conflict events.

As explained, the non-lootable and lootable sub-sets are then further divided into those with known production characteristics, through the information provided by MINEINFO variable and PRODyear variable.

The sub-sets were generated based on attribute selection using Structured Query Language (SQL) on MapInfo Professional 11.0.

The second step of the aggregation procedure was the reduction of the number of records with missing information: in order to achieve that result, all gold deposits within an area of 50km were grouped together.

Fig.2 provides an example of the buffering procedure applied to some deposits in Kenya. In the upper-right corner, defined by violet lines, a portion of Kenya is shown. Within this area there are two gold deposits represented by yellow rumbles. Such deposits lie at a distance contained in the aggregation criterion and they were aggregated into a unique entry sharing the same attributes of the original deposits. In this case, for example, the first deposit (KE002AU) holds discovery date and production date as known, contrarily, the second deposit (KE003AU) is not characterized by any temporal information in the dataset. Through the aggregation procedure, the known temporal attributes of the first deposit were extended to the second deposit. In order to provide comprehensive information, a separate field of the compact dataset indicates when the aggregation procedure was applied and identifies the primary key codes of the original deposits.

Thus, the buffer-polygons obtained were aggregated through a spatial joining procedure. The process, in details, involves a first operation in intersecting the polygons with a state boundary map and clipping them along the state boundaries. In this way, each group was assigned to a country.
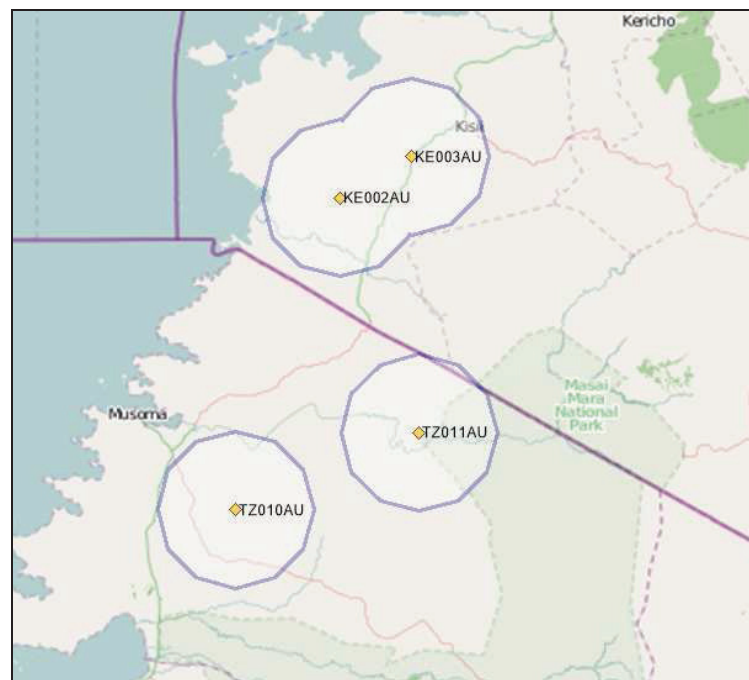


*Fig. 2   Aggregation procedure visualized on different cases in Kenya and Tanzania.*

Fig.2, for example, shows a small portion - lower part of the map – of Tanzania. Two deposits are visualized here: in the first case (deposit TZ011AU) the polygon intersects with the state border, without joining any other deposits. The deposit was clearly clipped to Tanzania.

GROUPID is a new variable, introduced in the compact version of the dataset, which uniquely identifies the combined deposits created by the spatial joining procedure of polygons-buffer.

Finally, the last step of the aggregation procedure was represented by the 'disaggregate' function. As already mentioned, once combined, the regions are complex features which are showed as a single polygon, but they contain separate entry points. The 'disaggregate' operation allows giving to each point the attribute values indicating which polygon falls within and thus which group it belongs to. In other words, the operation grouped together the records in the attribute table and their corresponding geometric shape (points). As result, in the compact version of GOLDATA there are several points represented with one record in the table. According to the aggregation function chosen, each point within a group shares the same attributes.

The variables and coding structure of the compact dataset are presented in the following table.

*Table 2.        GOLDATA compact version: variable definitions and coding structure*

| No. | Variable Name | Label | Aggregating function applied | Format |
|---|---|---|---|---|
| 1 | GROUPID | Unique identifier for each deposits' group | **** | Number (integer) |
| 2 | COUNT | Count Number | Count | Number (integer) |
| 3 | COUNTRY | Country of group location | Minimum | String |
| 4 | FIPS CODE | FIPS code for group location | Minimum | String |
| 5 | COW CODE | COW code for group location | Minimum | Number (integer) |
| 6 | CONT | Continent of group location | Minimum | Number (integer) |
| 7 | LAT | Latitude of group location | Avg | Number (three decimal places) |
| 8 | LONG | Longitude of group location | Avg | Number (three decimal places) |
| 9 | DISCyear | Discovery date | Minimum | Date (yyyy) |
| 10 | PRODyear | Starting production date | Minimum | Date (yyyy) |
| 11 | PRIMKEY | Primary Key | Count | String |

The aggregating functions applied are:

1. *Count*: it counts the number of records in each group.
2. *Avg*: it calculates the average of the values for all records in each group;
3. *Minimum*: it finds the lowest value for all records in a group. All points within a group hold equal values for COUNTRY, FIPSCODE and COWCODE, thus, in this case, the aggregating function leads to the original value for each category.

As far as concern production and discovery dates, the compact version does not show the dd/mm/yyyy format as applied in the original version: this field reports just the year unit in order to register the variable as integer type and, thus, making the aggregation functions applicable. Missing values are identifiable by the '9999', preferred to zero, so that the aggregate function 'minimum' could be used for the aggregation.

The compact version of GOLDATA appears more complete and functional than the original version: the number of rows and columns has been reduced and the records with missing attributes (especially the temporal dimension) have been decreased. Actually, each group of points, or multi-points, corresponds now with one row in the attribute table. Points are not grouped to other points if they are further away than 50 km or if they lie on the opposite sides of a state boundary.

*Tab.3 Results of the aggregation procedure.*

| | Original dataset | | Compact dataset | |
|---|---|---|---|---|
| | Production Date | Discovery Date | Production Date | Discovery Date |
| **GOLD_L** *321 records* | 10.17% | 13.79% | 23.62% | 26.72% |
| **GOLD_S** *324 records* | 29.80% | 29.08% | 39.42% | 39.66% |
| **GOLD_NL** *988 records* | 14.01% | 18.44% | 31.20% | 30.80% |

The number of deposits with missing information for discovery and production year is now substantially reduced. In the first category, there are now 137 sites with known production date and 155 sites with known discovery date. In the second category, there are 164 sites with known production date and 165 sites with known discovery date. Finally, in the third category, there are 642 sites with known production date and 634 sites with known discovery date. The values in the table express the percentage of data holding the reference attribute (production date and discovery date), by subsets.

## Profiles of the Countries reported in GOLDATA[6]

| | |
|---|---|
| **Albania**<br>First gold discovery: not available<br>First gold production: 1982<br><br>Albania holds some important mineral deposits, in particular chromite, copper, limestone, and petroleum. Gold exploitation is limited and gold reserves do not seem particularly significant. Data on mineral production are mostly unavailable. | **Algeria**<br>First gold discovery: not available<br>First gold production: 1952<br><br>Gold production in Algeria is mainly due to Tirek-Amesmessa Mine exploitation, in the southern part of the country. In 2010, recorded production was 723 kilograms. |
| **Angola**<br>First gold discovery: not available<br>First gold production: not available<br><br>Gold production is mainly artisanal and based on superficial exploitation of placer deposits. Several exploration activities are underway. Data on production are not available. | **Antigua and Barbuda**<br>First gold discovery: not available<br>First gold production: not available<br><br>Antigua and Barbuda possess mineral and metal resources which account for almost 3% of real GDP (data referring to 2010). Some gold occurrences lie in the islands. Gold production seems to be scarce. Data on production are not available |
| **Argentina**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Argentina holds considerable and large mineral and metal deposits, gold included. Gold is exploited in placer deposits as well as through vein extraction. In 2010, recorded production was 63,138 kilograms. | **Armenia**<br>First gold discovery: not available<br>First gold production: not available<br><br>Armenia possesses various resources' deposits, such as copper, gold, lead and zinc. Gold exploitation is still limited. In 2010, recorded production was 2,000 kilograms. |
| **Bahamas**<br>First gold discovery: before 1946<br>First gold production: 1980<br><br>Gold production is mainly focused in a few underground sites with limited concentration of the metal. Gold production seems to be scarce. Data on production are not available. | **Belize**<br>First gold discovery: 1952<br>First gold production: not available<br><br>Belize is not a significant mineral producing country and it holds few gold occurrences. Gold production seems to be scarce. Data on production are not available. |
| **Bolivia**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Bolivia possesses huge mineral and metal deposits and their exploitation account for considerable part of the country growth rate. Its resources have not been fully explored or developed, so there are still substantial uncertainties about total endowments. Gold is a common exploited metal, but it does not achieve a major production. | **Bosnia and Herzegovina**<br>First gold discovery: not available<br>First gold production: not available<br><br>The mineral industry contributed only a relatively small amount of value to the GDP. Gold production seems to be scarce. Data on production are not available |
| **Botswana**<br>First gold discovery: before 1946<br>First gold production: before 1946 | **Brazil**<br>First gold discovery: before 1946<br>First gold production: before 1946 |

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[6] Where expressed, 'first gold discovery date' and 'first gold production date' refer to the first known date reported for any of the deposits included in the dataset for a specific country, regardless whether other deposits are characterized by no available information.

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| Botswana is expected to hold considerable minerals and metals deposits, however the geology of the country is still poorly understood and limited information are available. Artisanal gold extraction is largely applied among the country. | Brazil's leading mineral exports are, in order of economic value, iron ore, gold. More than 2,500 gold occurrences, which are mostly vein deposits and alluvial placers, are known, however, there are largely still unexplored areas. Gold exploitation is increasing, especially in the States of Minas Gerais, Bahia and Para. |
| **Bulgaria**<br>First gold discovery: not available<br>First gold production: 1949<br><br>Bulgaria holds a very small mineral sector, basically focused on copper, lead, silver, steel, and zinc productions. Gold production is marginal and does not reach a significant economic value. | **Burkina Faso**<br>First gold discovery: not available<br>First gold production: 1980<br><br>Mining does not represent a significant role in Burkina Faso's economy. Gold exploitation, however, is likely to increase and become a relevant sector to the country's GDP. Gold production, indeed, increased by about 80% compared to 2009 production figures. |
| **Burma (Myanmar)**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The mineral sector in Burma is mainly based on cement, coal, copper, lead, natural gas and petroleum. Several gold deposits are known, although many of them are now out of production. Gold production is limited. Some exploration activities and geological mapping are planned. | **Cambodia**<br>First gold discovery: not available<br>First gold production: not available<br><br>Gold production is still marginal in Cambodia's economy. However, the country holds some deposits, not properly identified. Extensive exploration had been conducted on these areas, including geologic mapping, surface sampling, and drilling. |
| **Cameroon**<br>First gold discovery: 1988<br>First gold production: 1986<br><br>Gold represents a significant resource for Cameroon's economy, although it does not belong to the main mineral commodities produced. Gold is largely produced by small-scale artisanal miners in the eastern and northern parts of the country from alluvial and elluvial deposits. The southeast region had a few mineral deposits. | **Central African Republic**<br>First gold discovery: not available<br>First gold production: not available<br><br>Central Africa Republic is one of the major producers of diamond in the world. The country produces also gold, especially in the regions of Berberati, Haute-Kotto and Haute-Sangha. The majority of gold production is carried out through artisanal methods. |
| **Chad**<br>First gold discovery: 2001<br>First gold production: 2001<br><br>The mineral sector in Chad is dominated by hydrocarbons production. Some gold reserves are known and regularly exploited, however gold production is marginal in volumes. Placer deposits are exploited through artisanal and small-scale mining methods. | **Chile**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Despite a recent effort to diversify the economy, the mineral sector, dominated by the production of copper, accounts for a major share of the GDP. Gold is abundant and is exploited since ancient time in the country. Gold deposits are exploited through both artisanal and industrial methods. |
| **China**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>China is rich in mineral resources and is one of the world's leading producers of gold. China ranked among the top three countries in the world in the production of many other mineral commodities. Gold production is a significant component of the GDP country. Several deposits are still under exploration. | **Colombia**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Colombia holds a variety of mineral resources and is a leading producer several commodities such as nickel. Gold is abundant in the country and it is exploited since ancient time. Gold production is carried out through both artisanal and industrial methods. |

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| **Congo, Dem. Rep.**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Gold production is a significant sector in the country's economy. A relevant lack of transparency leads makes most gold exports undeclared: most of the reported gold exports from Burundi and Uganda are de facto re-re-exports from Congo, Dem. Rep. Artisanal and small-scale producers exploit gold in the Ituri District of Orientale Province, Nord-Kivu Province and Sud-Kivu Province. | **Congo, Rep.**<br>First gold discovery: not available<br>First gold production: not available<br><br>Gold production is increasing in the last years, analogously to copper and diamond productions. Several explorations are underway. Gold is largely produced by small-scale artisanal miners. |
| **Costa Rica**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The mining sector is a decreasing component of the country's GDP structure. Gold occurrences are largely reported in all country; however, available data are still limited. | **Cote D'Ivoire**<br>First gold discovery: not available<br>First gold production: not available<br><br>Côte d'Ivoire is an increasing producer of mineral commodities which include, among others, gold, manganese, natural gas and petroleum. Data are often not available and inadequate to make reliable estimates of locations, estimated reserves and production. |
| **Cuba**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Nickel represents the most important commodity in Cuba's mineral sector. Gold is exploited in several deposits; however, data on operation type are limited. Gold is a marginal production in terms of volumes. | **Czech Republic**<br>First gold discovery: not available<br>First gold production: not available<br><br>The Czech Republic has no economically significant mineral resources. Coal is widely exploited and it holds a regional importance. Gold exploitation is marginal. |
| **Dominica**<br>First gold discovery: not available<br>First gold production: not available<br><br>Gold exploitation in Dominica is a marginal activity, as in general all the mineral industry. Gold is mainly extracted by artisanal and small-scale methods in superficial deposits. | **Dominican Republic**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The Dominican Republic, despite its limited geographical extension, holds significant mineral deposits, in particular nickel reserves. Gold is widely exploited, trough industrial and artisanal methods, and its relevance is increasing in the mineral industry. |
| **Ecuador**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Ecuador is endowed with huge mineral reserves; however, the mineral sector is not still properly developed. Gold is abundant in the country and it is exploited since ancient time. Artisanal and small-scale mining techniques are commonly applied, particularly in placer deposits. | **Egypt**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Egypt's mineral reserves are known since ancient time. Several commodities are produced, including gold, although the minerals sector is dominated by petroleum and natural gas exploitation. Gold production mainly derives from large superficial operations – open pit mines – and is expected to increase due to recent exploration activities and investments. |
| **El Salvador**<br>First gold discovery: before 1946<br>First gold production:  before 1946<br><br>The mineral sector in El Salvador is limited and | **Equatorial Guinea**<br>First gold discovery: not available<br>First gold production: not available<br><br>Equatorial Guinea has developed a small mineral |

| mainly based on cement and iron. Gold is produced in small quantities. Data on operation type and mineralization typology are scarce. Artisanal mining is recorded in several superficial deposits. | industry, mainly based on petroleum and natural gas exploitation. Gold reserves seem limited, however reliable data on geological mineralization are scarce. Artisanal methods are largely applied, especially in Aconibe and Coro regions. |
|---|---|
| **Eritrea**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Eritrea is mainly characterized by a greenstone belt which covers about 70% of the country. Several precious metals deposits are located within this area, including gold. Gold is largely exploited by both artisanal and industrial methods. However, recorded gold production is limited in volumes. | **Ethiopia**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Ethiopia holds considerable mineral reserves, although it is still not a significant consumer of minerals. The main productions are tantalum, cement and gold. Gold is located in superficial and vein deposits and it is largely exploited by artisanal and small-scale mining methods. Gold production is expected to increase due to recent investment in the sector. |
| **Fiji**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Fiji has a quite developed mineral industry, based mainly on the production of cement, gold, and silver, and exploration for oil offshore. Gold constitutes a relevant production in the country's total output. Several exploration activities are underway. | **French Guiana**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The leading mineral commodity produced and exported by French Guiana is gold. Gold exploitation accounts, indeed, for a considerable percentage of GDP. Gold reserves are expected to be relevant and several exploration activities are underway. Gold is exploited by both artisanal and industrial methods. |
| **Gabon**<br>First gold discovery: 1980<br>First gold production: not available<br><br>Gabon's mineral sector is mainly based on the production of manganese and petroleum. Several other mineral commodities are produced in the country, including cement, diamond and gold. Artisanal and small-scale methods are still commonly applied in gold exploitation. Several exploration activities are underway. | **Georgia**<br>First gold discovery: not available<br>First gold production: not available<br><br>Georgia's mineral sector was considerably developed until its independence in 1991. During the subsequent turmoil and re-structuring phase mineral sector has been largely reduced. Gold exploitation is marginal and is mainly characterized by superficial operations. |
| **Ghana**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The mineral sector represents a prominent part of Ghana's economy. Ghana is among the world's top 10 producers of gold and has a considerable production of diamonds. Gold is exploited since ancient time in the country. Both artisanal and industrial techniques are applied. | **Greece**<br>First gold discovery: not available<br>First gold production: 1995<br><br>Greece exploits precious metals and other mineral commodities since ancient time. Gold production is active in superficial and underground extraction operations. However, gold production is still limited in volumes and economic value. Insufficient investments undermine the development of the mineral sector. |
| **Guatemala**<br>First gold discovery: 1998<br>First gold production: 1998<br><br>Guatemala has significant gold reserves. Both artisanal and industrial methods of extraction are widely applied. Alluvial deposits are mainly exploited by individuals and small-scale mining operations. Gold production is expected to increase due to ongoing explorations and investments. | **Guinea**<br>First gold discovery: 1988<br>First gold production: 1995<br><br>The most relevant mineral reserves of Guinea are bauxite and diamonds. Guinea produces also several other commodities such as cement, gold and salt. Gold is mainly exploited in open pit mines. Exploration and scoping activities finalized to the increase of gold production are underway. |

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| **Guyana**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Guyana holds some significant mineral resources. The mineral sector is mainly based on the production of bauxite, diamond and gold. Gold is exploited in superficial deposits, mainly alluvial. Consequently, artisanal and small-scale mining techniques are widely applied in gold exploitation. | **Haiti**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Despite its geographical limited extension, Haiti has some significant mineral resources. Gold is mainly located in the north of the country which has been relatively unaffected by the recent earthquake. Gold is exploited by both artisanal and industrial methods. |
|---|---|
| **Honduras**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Minerals exploitation represents about 2% of the GDP in Honduras and its relevance is growing. Gold exploitation holds a significant part of the total production. Several gold deposits are located in the country. Artisanal methods of extraction are widely applied. | **Hungary**<br>First gold discovery: not available<br>First gold production: not available<br><br>Hungary's minerals sector is limited and mining makes up only a small part of the country's economy. Gold production is marginal and not properly developed. |
| **India**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>India has considerable reserves of minerals throughout the country's extension. The mineral sector provides the basic raw materials—such as coal, copper and industrial minerals—to the growing domestic manufacturing sector.<br>Gold production is increasingly carried out by industrial methods, but does not represent a primary production respect to other commodities. | **Indonesia**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Indonesia is a very rich country in terms of mineral resources, including coal, copper, gold, natural gas, nickel, and tin. It is one of the world's top 10 producers of gold. Gold is exploited since ancient time by both artisanal (especially in alluvial deposits) and industrial methods. Several exploration activities are underway. |
| **Iran**<br>First gold discovery: not available<br>First gold production: 1966<br><br>Iran's mineral sector is dominated by crude oil and natural gas production. Other mineral commodities are produced by the country. Gold constitutes a marginal production. Some pilot studies and exploration activities are underway and gold sector is expected to increase in the future. Gold deposits are exploited by artisanal methods also. | **Ireland**<br>First gold discovery: not available<br>First gold production: not available<br><br>Ireland is the major European producer of zinc and a significant producer of alumina and lead. New exploration activities are underway, with main attention on gold. Gold production is still marginal, but it is expected to increase. |
| **Jamaica**<br>First gold discovery: not available<br>First gold production: before 1946<br><br>Jamaica is endowed with some significant mineral resources, namely bauxite. Gold is exploited, but data about operation type and productions are limited. Gold production is a marginal production. | **Japan**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Japan holds a variety of mineral resources and is a significant producer of several commodities. Gold is exploited since ancient time in superficial and underground deposits. Gold accounts for a considerable part of the mineral sector. |
| **Jordan**<br>First gold discovery: not available<br>First gold production: not available<br><br>Jordan's mineral sector is mainly based on phosphate and cement, which are largely exported. Gold | **Kazakhstan**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Kazakhstan is a leading producer of several mineral commodities, such as uranium, chromium and |

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|---|---|
| constitutes a marginal production and does not reach significant economic volumes. Artisanal and small-scale methods are applied. | titanium, among others. Gold production is significant and accounts for a considerable percentage of the mineral sector. Significant exploration activities are underway, with special emphasis on gold occurrences. Gold is exploited through both artisanal and industrial methods. |
| **Kenya**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Kenya holds some significant mineral reserves; however is not either a globally relevant producer or consumer of minerals. Gold exploitation, especially through artisanal and small-scale methods, is carried out in the country since ancient time. Gold production is recently increasing in volumes, although still limited compared to expected reserves. | **Korea North**<br>First gold discovery: not available<br>First gold production: not available<br><br>Minerals mainly extracted in North Korea are coal, gold, iron ore, limestone, magnesite and zinc. Gold accounts for a considerable share of the mineral sector. Reliable data on operation type and mineralization typology are not available. Gold deposits are mainly located in Yanggang province. |
| **Korea, South**<br>First gold discovery: not available<br>First gold production: not available<br><br>The mineral sector in South Korea is limited and mainly based on copper, gold, iron and nickel. Gold is exploited in several deposits; its production is significant in economic value and volumes. Data on gold occurrences and operation type are scarce. An extensive phase of exploration activities is underway. | **Kyrgyzstan**<br>First gold discovery: before 1946<br>First gold production: 1970<br><br>Kyrgyzstan is endowed by a large variety of mineral resources. Gold production accounts for more than 90%, in economic value, of the total mineral production. Gold reserves are expected to be highly significant and attract several foreign investments. Gold production is carried out through both artisanal and industrial methods. |
| **Laos**<br>First gold discovery: not available<br>First gold production: not available<br><br>Laos holds significant mineral endowments, included gold. The country produces a variety of mineral commodities such as copper, silver and gold. Gold exploitation is carried in several superficial and underground deposits. Such production reaches a significant economic value. Artisanal techniques of extraction are also applied. | **Liberia**<br>First gold discovery: not available<br>First gold production: not available<br><br>The most relevant commodities produced by Liberia are cement, diamond and gold. The mining sector was deeply affected by the effects of the recent 14-years civil war. Gold reserves seem to be relevant, but more detailed surveys and exploration activities are underway. Gold is largely exploited by artisanal methods. Reliable data on deposits and mineralization are scarce. |
| **Macedonia**<br>First gold discovery: not available<br>First gold production: 1978<br><br>The mineral sector in Macedonia is limited; however the country produces a number of metals, gold included, as well as industrial minerals and lignite. Gold production is marginal. | **Madagascar:**<br>First gold discovery: not available<br>First gold production: not available<br><br>Madagascar is one of the world's top-ranked producers of some gemstones, in particular sapphires. Some gold deposits are known and exploited, however several geological surveys are underway. Gold production is still marginal in economic volumes. |
| **Malawi**<br>First gold discovery: not available<br>First gold production: not available<br><br>Malawi's mineral sector is largely based on copper, nickel and uranium production, beyond some gemstones production, such as amethyst, garnet, ruby | **Malaysia**<br>First gold discovery: 1958<br>First gold production: not available<br><br>Malaysia's major mineral resources are bauxite, clays, coal, copper, gold, natural gas, petroleum, silica, silver. Gold production is carried out through both |

and sapphire. Gold production is marginal and does not represent a significant economic figure. Data on gold occurrences are still limited.

artisanal and industrial methods. There are several operating gold mines in the country; all are located in the States of Kelantan, Pahang, and Terengganu.

| **Mali** | **Martinique** |
|---|---|
| First gold discovery: not available<br>First gold production: 1987<br><br>The mineral sector in Mali is dominated by gold production. No other mineral commodities, indeed, reach significant level of production in the country, with the exception of rock salt and semiprecious stones. Artisanal methods are widely applied – especially in Kenieba region – as well as industrial production. Mali has some deposits of diamonds also. | First gold discovery: not available<br>First gold production: not available<br><br>Martinique is a small producer of mineral commodities. Gold production is marginal. Artisanal and small-scale mining are commonly applied in gold exploitation. |
| **Mauritania** | **Mexico** |
| First gold discovery: 1946<br>First gold production: 1970<br><br>Mauritania holds significant reserves of iron, copper and gold. The mineral industry is growing, associated to an increase in investments. Gold is exploited by both small-scale mining and industrial methods. | First gold discovery: before 1946<br>First gold production: before 1946<br><br>Mexico is endowed with huge mineral reserves and the mineral sector accounts for a major share of the country's economy. Gold is abundant and exploited since ancient time. There are several deposits, both alluvial and underground mineralization. Artisanal and small-scale mining are largely applied at local level. |
| **Mongolia** | **Morocco** |
| First gold discovery: before 1946<br>First gold production: before 1946<br><br>Mongolia is endowed with large reserves of mineral commodities, such as coal, copper, fluorspar and gold. Gold exploitation is carried out since ancient time. Gold production accounts for a significant share of the mineral sector. It is expected to increase due to large investments and new exploration activities. | First gold discovery: before 1946<br>First gold production: before 1946<br><br>Morocco has several precious metals deposits, in particular gold and silver, located in the Anti-Atlas region. Gold is exploited since ancient time and it is increasing in production, even if it does not still represent a primary economic activity. Several exploration activities are underway. |
| **Mozambique** | **Namibia** |
| First gold discovery: before 1946<br>First gold production: before 1946<br><br>The mineral sector is increasing in relevance in Mozambique's economy, in particular referring to aluminium, beryl and tantalum. Mozambique has several gold deposits, however, artisanal and small-scale mining account for about 90% of the total gold production. As a consequence, monitoring such activities is difficult and data are often not available. | First gold discovery: 1972<br>First gold production: 1975<br><br>Namibia has a growing mineral sector, mainly based on diamond, fluorspar, gold and uranium. Gold production is significant and is carried out by artisanal methods also. On-going investments and exploration activities make reliable the increase of gold exploitation. |
| **New Zealand** | **Nicaragua** |
| First gold discovery: before 1946<br>First gold production: before 1946<br><br>New Zealand is a producer of a variety of mineral commodities, including bauxite, chromium, copper, gold, silver iron, lead, lithium, among others. Gold production is significant in economic values. Gold exploitation, mainly done in open pit mines, is expected to increase due to large investments and recent exploration activities. | First gold discovery: before 1946<br>First gold production: not available<br><br>Minerals exploitation represents about 1% of the GDP in Nicaragua and its relevance is growing. Several gold deposits are located in the country. Artisanal and small-scale mining of gold by individual or cooperative miners, characterize a relevant part of the total gold production. |
| **Niger** | **Nigeria** |
| First gold discovery: 1985 | First gold discovery: before 1946 |

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| First gold production: 1994<br><br>The mineral sector in Niger is dominated by the production of uranium. Other mineral commodities produced in the country include cement, coal, silver and gold. Gold production could benefit from the several exploration activities which are underway. Artisanal techniques of extraction are largely applied. | First gold production: not available<br><br>Nigeria's economy is largely based on crude oil production and export. However, the country is promoting a deep diversification of the mineral sector. Gold production is a stable activity in the country and it is expected to increase. Artisanal techniques of extraction are largely applied. Data on deposits location and mineralization typology is still limited. |
| **Oman**<br>First gold discovery: 1974<br>First gold production: 1983<br><br>Oman's mineral sector is dominated by hydrocarbons production, which represents a major component of the country's economy. Gold production is marginal. | **Pakistan**<br>First gold discovery: not available<br>First gold production: 1962<br><br>Pakistan is a producer of coal, copper, iron ore, limestone and salt. Gold production is marginal and does not reach significant volumes. Gold is mainly exploited in superficial occurrences and placers. Data on operation type and mineralization typology are limited. |
| **Panama**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Panama holds some considerable mineral resources, mainly cement, gold and salt. Gold production accounts for a significant percentage of Panama's GDP. Gold is exploited in superficial as well as in underground deposits since ancient time. Artisanal methods of extraction are commonly applied. | **Papua New Guinea**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The more significant mineral commodities produced in Papua New Guinea are copper, gold and silver. Gold production accounts for a considerable share of the country's mineral sector. At global level, the country is a world leading gold producer. Gold is exploited through artisanal and small-scale mining methods also. |
| **Paraguay**<br>First gold discovery: not available<br>First gold production: 1990<br><br>Differently to other countries in Latin America, gold production in Paraguay is marginal. The mineral sector is dominated by other mineral commodities, such as cement, iron and clays. The recent discovery of natural gas deposits has become the prominent issue. Gold production is mainly based on superficial operations and exploitation of alluvial deposits. | **Peru**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The mineral sector in Peru constitutes a relevant share of the country's GDP. Peru is a leading producer of several mineral commodities in Latin America, including gold. Gold is largely exploited in the country since ancient time. Gold production is carried out through both artisanal and industrial methods. |
| **Philippines**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The mineral sector of Philippines is mainly based on the production of nickel, cement, copper, gold and silver. Gold production accounts for a significant percentage of Philippines' economy. Gold is exploited in superficial as well as in underground deposits. Artisanal and small-scale mining are also applied. | **Romania**<br>First gold discovery: not available<br>First gold production: 2003<br><br>Romania is a significant producer of some mineral commodities, such as copper, iron ore, lead and zinc. Gold production is marginal and does not achieve significant volumes. |
| **Russia**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Russia is one of the leading producers of minerals at global level. Among others, Russia produces huge volumes of copper, diamond, gold, iron, nickel, | **Rwanda**<br>First gold discovery: not available<br>First gold production: not available<br><br>The mineral sector in Rwanda does not represent a primary component of the national GDP. However, Rwanda is a relevant producer of tantalum at global |

beyond natural gas and petroleum. Gold production is carried out since ancient time through both artisanal and industrial methods. Data on deposits location and typology are often not available.

level. Gold is a marginal production and is mainly recovered by artisanal and small-scale methods. Important exploration activities for gold resource are underway in Byumba, Gicumbi district.

**Saudi Arabia**
First gold discovery: 1954
First gold production: 1988

Saudi Arabia's mineral sector is dominated by hydrocarbon production which represents the dominant component of the country's economy. Copper, gold, silver and zinc are also produced in considerable amounts. Gold production is expected to increase due to large investments and new exploration activities.

**Senegal**
First gold discovery: not available
First gold production: not available

The mineral sector of Senegal is quite limited, although the country holds some considerable mineral resources, such as phosphate, basalt and natural gas. Gold achieves a significant production. Gold deposits are mainly located in Sabodala district.

**Sierra Leone**
First gold discovery: not available
First gold production: not available

Sierra Leone's economy is dominated by the production and export of diamonds. However, the country produces other significant mineral commodities such as bauxite, cement, gold, and ilmenite. Gold is considerably diffuse in Sierra Leone, but geological information is still too limited to set up exploitation with industrial methods. Gold is largely collected through artisanal methods from its alluvial deposits.

**South Africa**
First gold discovery: before 1946
First gold production: before 1946

The South Africa's mineral endowments are significant at global level. The country is one of the leading producers of several mineral commodities and is estimated to hold 12% of world reserve of gold. Gold production, both through artisanal and industrial methods, is carried out since ancient time. The recent trend indicates a reduction in gold production volumes.

**Spain**
First gold discovery: not available
First gold production: 1967

Within the European context, Spain is a country characterized by a significant and diversified mineral sector. Gold is exploited through superficial and underground operations in several mines dislocated across the country. Formal records show a stable gold production in terms of volume.

**Sudan**
First gold discovery: not available
First gold production: 1950

Sudan's mineral sector is dominated by crude oil extraction. The country produces some other mineral resources such as copper, gold, silver and zinc. Gold production is mainly based on the activity of small artisanal miners.

**Suriname**
First gold discovery: before 1946
First gold production: before 1946

Suriname is a producer of several mineral commodities, such as bauxite, cement, copper, gold, iron ore, and petroleum. Gold is exploited in superficial as well as underground deposits. Artisanal methods are applied also. Gold production is expected to increase due to recent gold discoveries in Cassador and Saramacca.

**Taiwan (China)**
First gold discovery: before 1946
First gold production: before 1946

The mineral sector of Taiwan is quite limited. The country is a producer of coal, oil and some other minerals. Gold production is significant. Gold is mainly exploited in underground deposits, but, after decades of extraction, gold reserves have been deeply reduced.

**Tajikistan**
First gold discovery: 1977
First gold production: 1986

Tajikistan has large endowments of mineral resources such as copper, gemstones, gold, iron ore, lead, manganese. The mineral sector is growing and gold exploitation covers a significant part of it. Gold is exploited in superficial as well as underground

**Tanzania**
First gold discovery: not available
First gold production: 1990

Tanzania is a significant producer of several mineral commodities. Gold production represents the most important one. Gold is exploited in superficial and underground deposits. Artisanal and small-mining activities are largely reported. Gold production is

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| deposits. | expected to increase due to relevant underway exploration activities. |
| **Thailand**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Thailand is a leading producer of cement and tin. The country produces other mineral commodities, including gold. Gold production is significant in economic value and is expected to increase due to several exploration activities which are underway. | **Tunisia**<br>First gold discovery: not available<br>First gold production: not available<br><br>The mineral sector in Tunisia is mainly based on the production of phosphate rock and some other mineral resources, including hydrocarbons. Some gold occurrences are located in the country. Gold production is marginal and does not achieve significant volumes. |
| **Turkey**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Gold is exploited in Turkey since ancient time. The country is a significant producer of several mineral commodities, including precious metals. Gold production is based on both artisanal and industrial methods of extraction. The majority of gold deposits are characterized by superficial exploitation techniques. | **Uganda**<br>First gold discovery: before 1946<br>First gold production: 1956<br><br>Uganda is a producer of cobalt, gold, iron, lead, tantalum and other mineral commodities. Gold production is still marginal, but gold reserves are expected to be significant. Several geological surveys and exploration activities are underway. A high percentage of gold export is identified as re-export on Congolese (Kinshasa) gold. Artisanal and small-scale mining methods are largely applied. |
| **Ukraine**<br>First gold discovery: not available<br>First gold production: 1980<br><br>Ukraine is a leading producer of several mineral commodities, such as gallium, rutile, titanium sponge and iron ore. As regards gold occurrences, the production is marginal and does not achieve a significant level. | **United Kingdom**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The mineral sector is mainly based on coal, natural gas and petroleum. Gold production is limited. Several occurrences are located in northern Ireland. Provable gold reserve seem to be not particularly significant. |
| **Uruguay**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Uruguay's mineral sector is mainly based on the production of clays, gold, iron ore and semiprecious gemstones. Gold production is significant in volume and economic value. Artisanal and small-scale mining activities are reported. Several exploration activities are underway for new gold projects identification. | **Uzbekistan**<br>First gold discovery: before 1946<br>First gold production: 1958<br><br>Although Uzbekistan holds significant mineral resources, notably copper, gold and uranium, the mineral sector is still limited. Gold production, in particular, is far from the country's mining potential. Huge gold endowments have been proven. |
| **Venezuela**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>The hydrocarbon sector is the dominant component of Venezuala's mineral sector. The country produces also significant level of coal, iron ore, gold, nickel, diamond and bauxite. Gold production is significant in economic value and volume. Gold exploitation is carried out since ancient time and it is mainly concentrated in Bolivar state. | **Vietnam**<br>First gold discovery: before 1946<br>First gold production: before 1946<br><br>Vietnam is a significant producer of cement and tin, beyond a considerable production at regional level of crude oil. Gold is exploited in surface and underground deposits. Gold production is significant in volume and economic value. |
| **Zambia**<br>First gold discovery: before 1946<br>First gold production: before 1946 | **Zimbabwe**<br>First gold discovery: before 1946<br>First gold production: before 1946 |

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| Zambia's economy is traditionally dominated by copper production and export. Copper price volatility on international market has made Zambia's economy, as well as the development of the mineral sector, highly vulnerable to external shocks. Gold is largely exploited by artisanal and small-scale mining methods. Gold production is expected to increase due to ongoing investment and exploration activities. | The mineral sector in Zimbabwe is mainly characterized by platinum and palladium productions. Gold is largely exploited through underground operations and it is expected to increase due to significant ongoing investments and exploration activities. |
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