Alluvial gold – Exploration and investment policies - an interplay, Zimbabwe

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Structure outline

1. Conditions for the formaton of alluvial gold

Introduction

- Mechanical weathering – Placers deposits.
- Formation conditions of placer deposits.
- Characteristics of placer deposits.
- Classification of placer deposits based on formation e,g, fluvial and
- Sites of accumulation of alluvial placers
- These should be linked to the type/ size of the exploration area beacuse the whole stretch of a river does not host economic gold deposits.

2. Exploration title/ investment policies

- Exclusve Prospecting Orders
- Special Grants under part X1X of the Mines and Minerals Act

3. Examples of placer deposits.

ECONOMIC GEOLOGY

Alluvial gold – Investment policies, exploration targeting and mining- an interplay

- **Principles of alluvial gold:**

- **Introduction**
  - **This presentation highlights environments in which alluvial gold may be concentrated. The aim is to show the wide diversity of the alluvial depost-types so that appropriate titles and tenure for their exploraton are discussed.**
  - **Firstly, the general conditions neccessary for the formation of placer deposits are discussed, then examples of such deposits in Zimbabwe are presented.**
  - **Formation of these deposits in Zimbabwe is similar to that in other parts of the world such as Australia, Brazil, Canada, Ghana, Papua New Guinea, New Zealand, USA, and Russia just to mention a few. Some of these countries have developed good practices for mining alluvial gold, especially how to minimize environmental impacts and increase mining efficiency.**
  - **These countries have benefited immensily from mining placer gold deposts.**
  - **Importantly, a mining operation will go through a life cycle from start-up phases through closure and finally rehabilitation.**

Formation conditions of placer deposits

- **SOURCE OF GOLD- Shear zones, quartz veins etc from a close gold camp**
- **TRANSPORT AND CONCENTRATION**

➢ The concentration agents are:

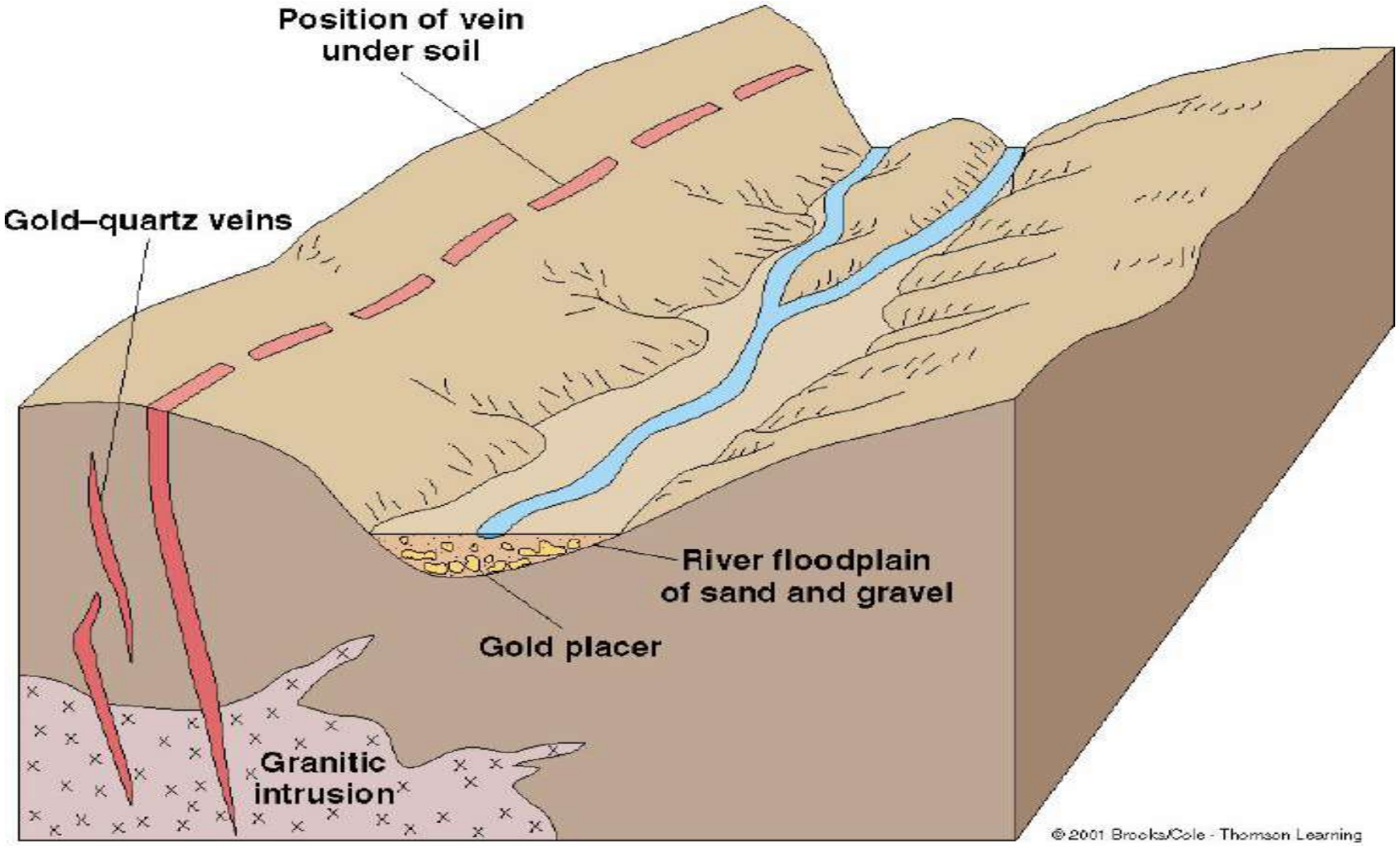
I. Wind: not very effective

II. Rain fall: only of very local interest

III. Moving water: It is the main concentration agent in nature. e.g. rivers, or beach.

➢ Usually, the placer deposit is the coarsest deposit within the valley, directly overlying the valley bottom.

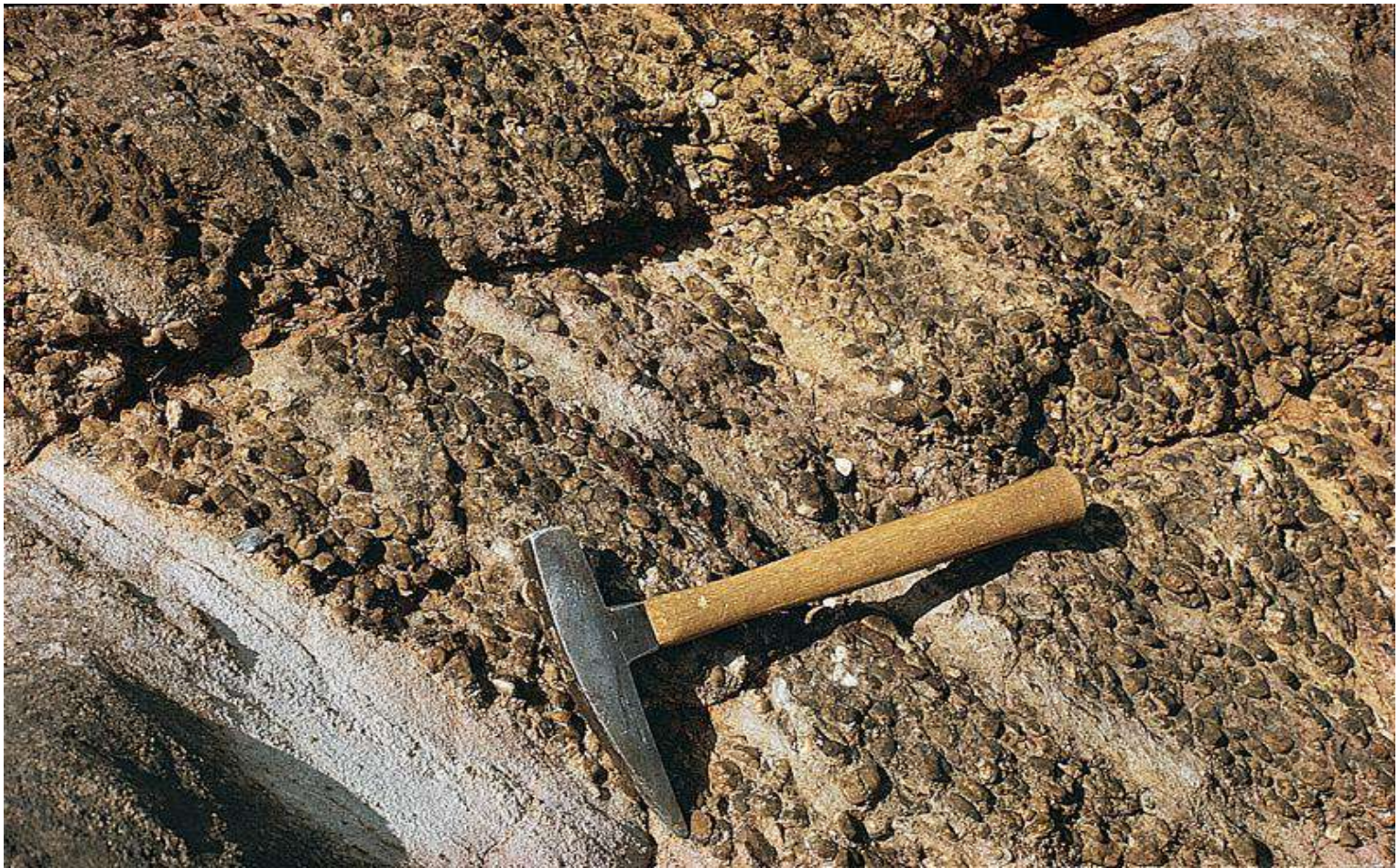
This figure shows how a **gold placer** can form.
A source of gold (a quartz-**vein**) is eroded and grains of gold are washed downhill into the stream. The grains are concentrated in the bottoms of the channel by flowing water, which washes away lighter particles and leaves the heavy gold behind.



(a) Ancient river pattern

Formation conditions of placer deposits

- **PROTECTION**
  - Protection against erosion after the unconsolidated concentrate has been formed e.g. potholes, rapids, meanders etc.



Classification of Placers

- **Fluvial placers**

  a) Largely residual, para-autochthonous, transport distance, 500 – 800 m.

  b) Alluvial, allochthonous placers, transport distance up to several hundred of kilometres.

- **Beach placers,** allochthonous, large transportation distance

  a) Marine beaches

  b) Lacustrine beaches.

- **Desert or eolian placers,** para-autochthonous, short transportation distance.

Classification of placer deposits

MODE OF ORIGIN	CLASS (Traditional usage)	USAGE IN MACDONALD (1983)
Accumulation *in situ* during weathering	Residual placers	Eluvial
Concentration in a moving solid medium	Eluvial placers	Colluvial
Concentration in a moving liquid medium (water).	Stream or alluvial placers Beach placers Offshore placers	Fluvial Strandline Marine placers
Concentration in a moving gaseous medium (air)	Aeolian placers	Desert or coastal aeolian

Residual Placers

- **Residual placers** accumulate immediately above a bedrock source (e. g. gold-bearing quartz vein) by the chemical decay or removal of the lighter rock materials.

- Residual placers only form where the ground is fairly flat;

- When there is a slope, creep will occur and eluvial placers will be generated.

Eluvial placers

- **Eluvial Placers** are formed on hill slopes from minerals released from a nearby source rock.

- The heavy minerals collect above and just downslope of the source and the lighter non-resistant minerals are dissolved or swept downhill by rain wash or are blown away by the wind.

- This produces a partial concentration by reduction in volume, a process which continues with further downslope creep. Obviously, to yield a workable deposit this incomplete process of concentration requires a rich source.

- In some areas with eluvial placers, the economic material accumulate in pockets in the bedrock surface.

Sites of accumulation of alluvial placers

- **Sites of accumulation**

- Deposition in flowing meandering streams/ rivers. The faster water is on the outside curve of meanders and slack water is opposite.

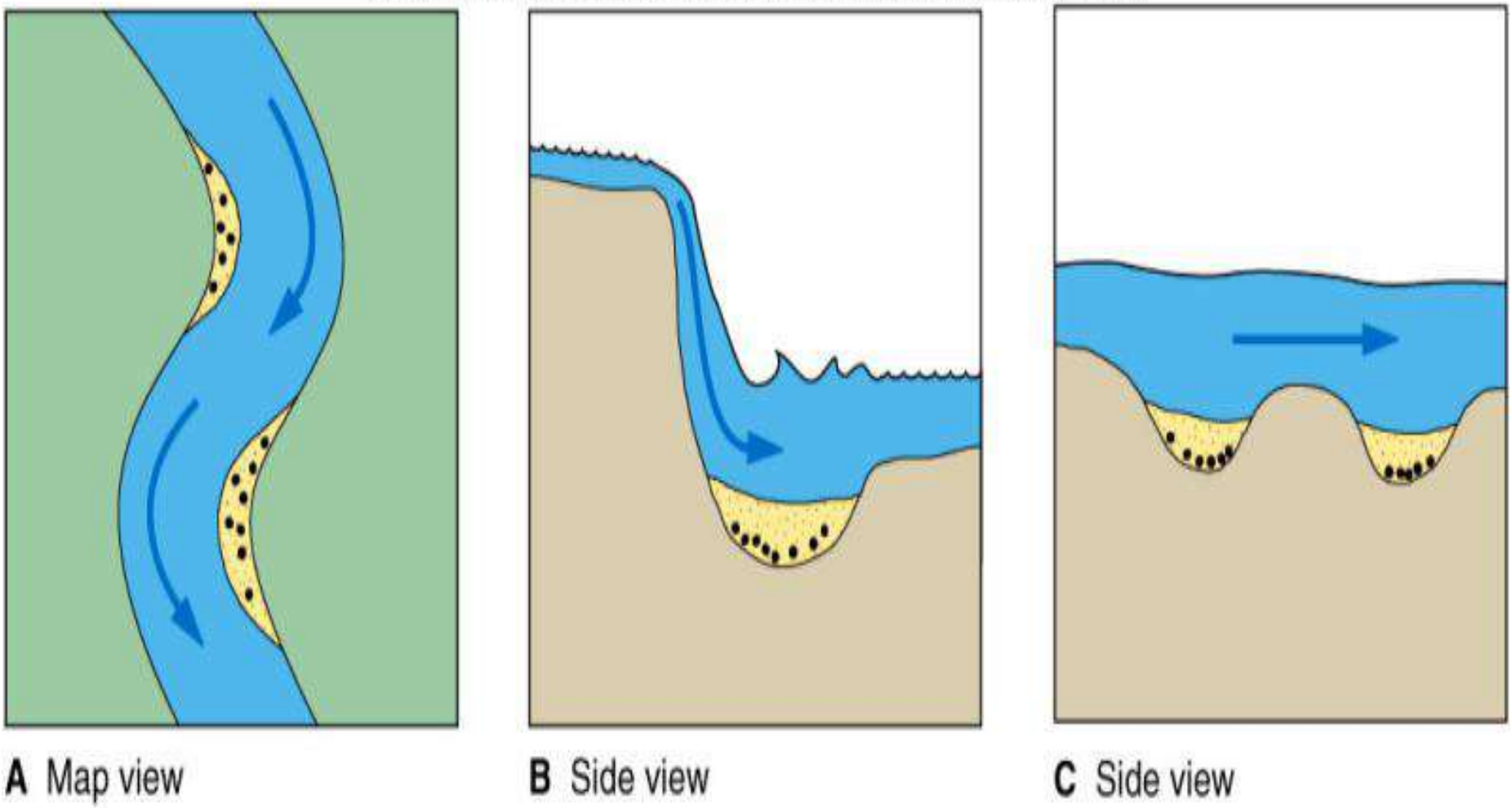
- Waterfalls and potholes

- Confluence of a swift flowing stream with a slower main river

- Accumulations in sand bars

- Accumulation in riffles and irregularities along the channel floors

Sites of accumulation of alluvial placers



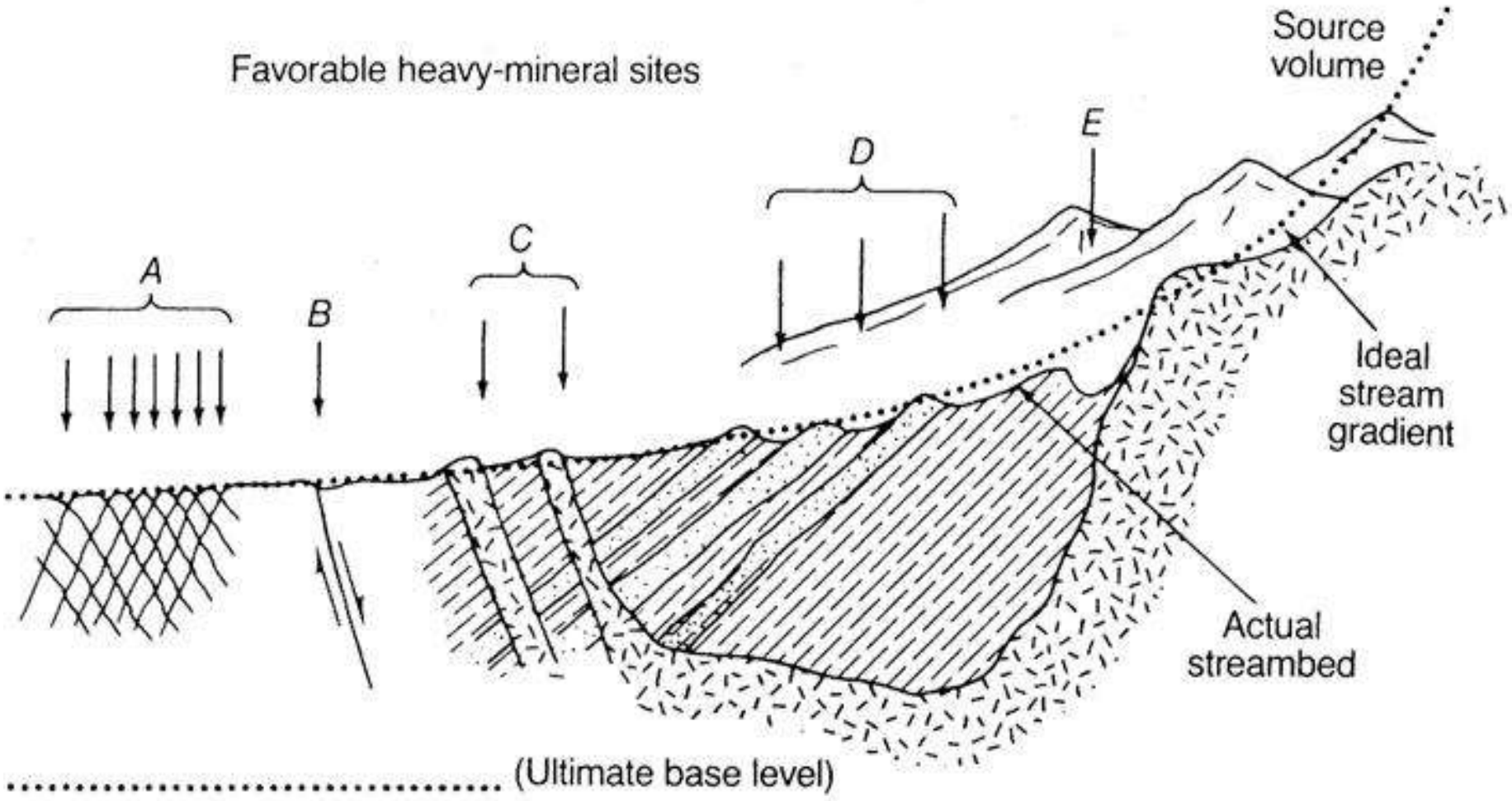
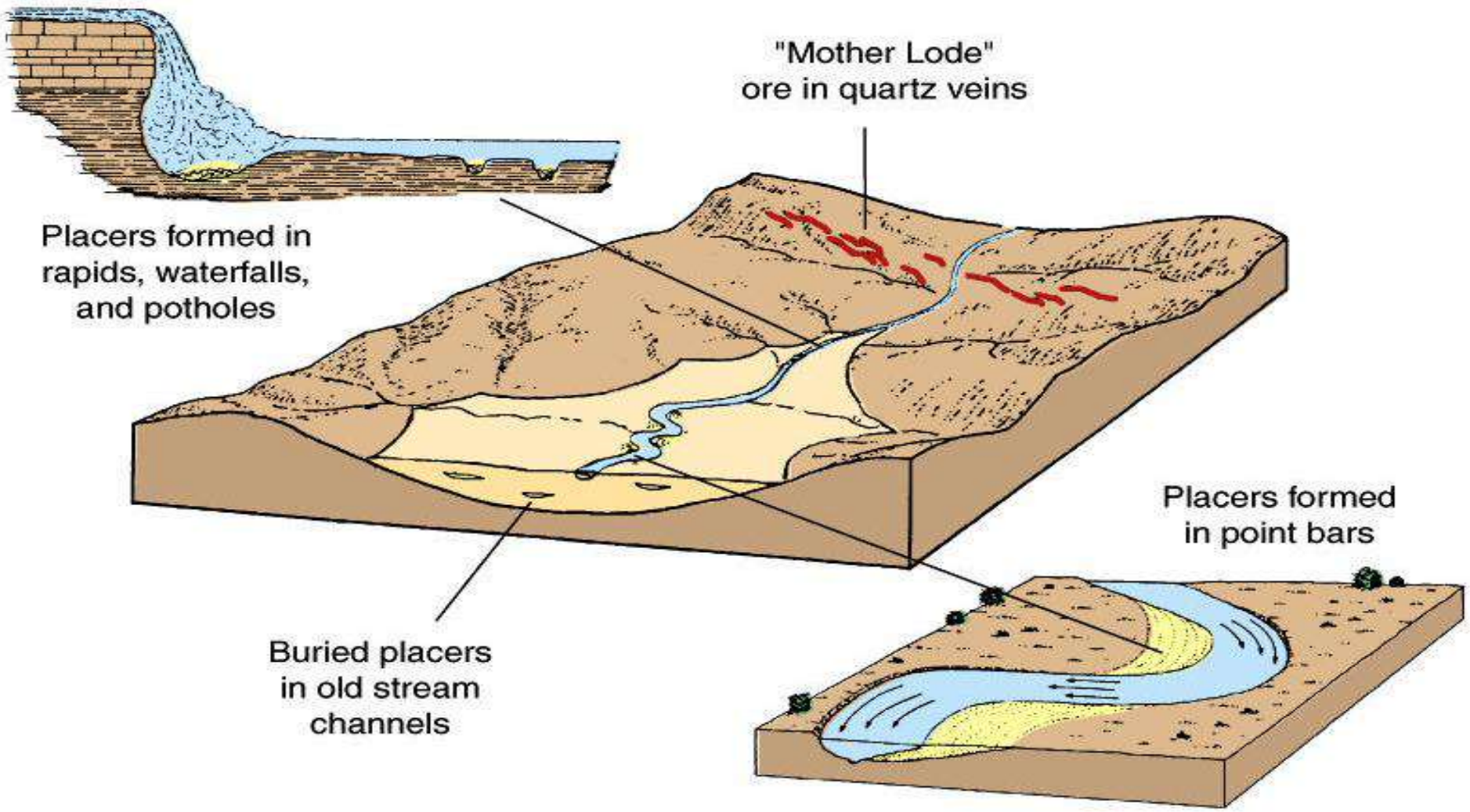
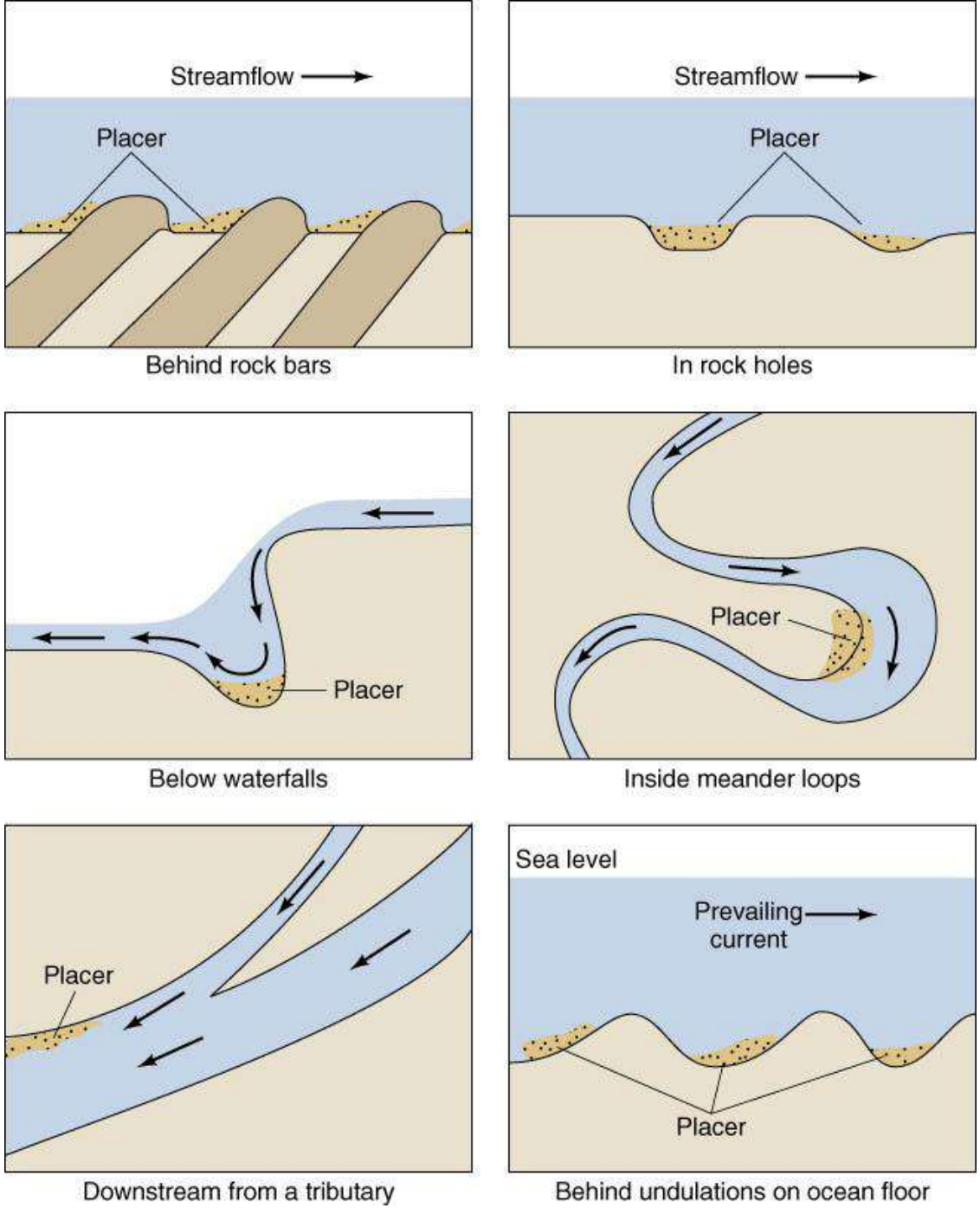


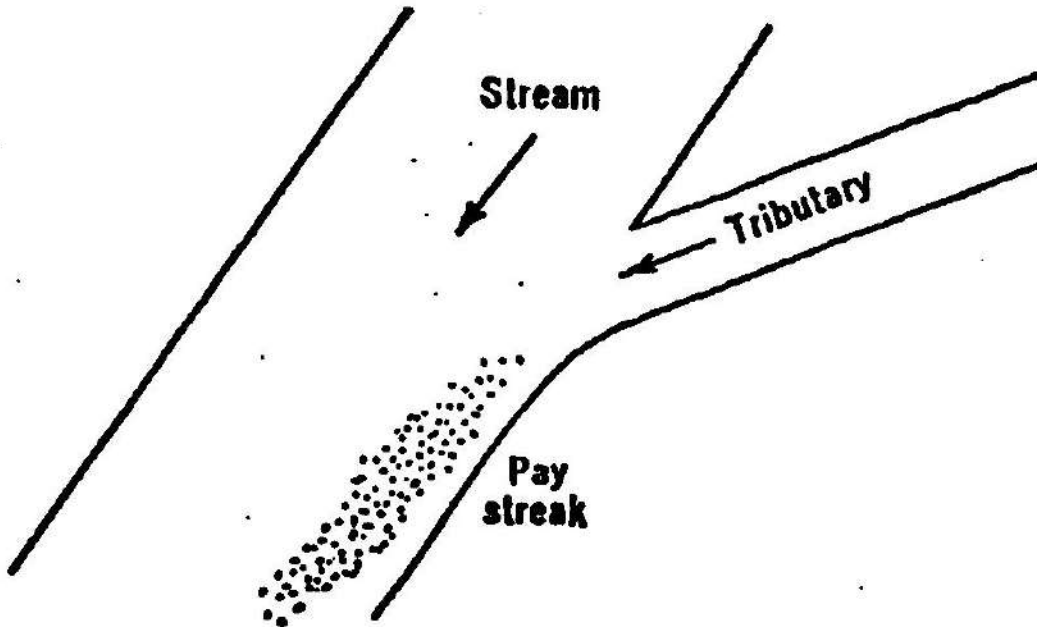
Figure 16-1. Favorable sites along a hypothetical stream profile for the accumulation of heavy minerals being carried downstream from a source volume include crevices formed by steep joints *A*, faults *B*, or outcrops of resistant dikes *C* or strata *D*, and plunge pools *E*, eddies, or potholes in rapids.

Formation of Placer Deposits




Streamflow
Placer
Behind rock bars
Streamflow
Placer
In rock holes
Placer
Below waterfalls
Placer
Inside meander loops
Placer
Downstream from a tributary
Sea level
Prevailing current
Placer
Behind undulations on ocean floor

Tributary into main stream



Case studies of placer gold deposit-types in Zimbabwe

1.Fluvial (residual and current river channel)

e.g. Angwa River Valley

2. Fluvial (old river channel)

e.g. Mutare River Valley, “Let's we forget”.

3. Fluvial (Fault/ outcropped blocked)

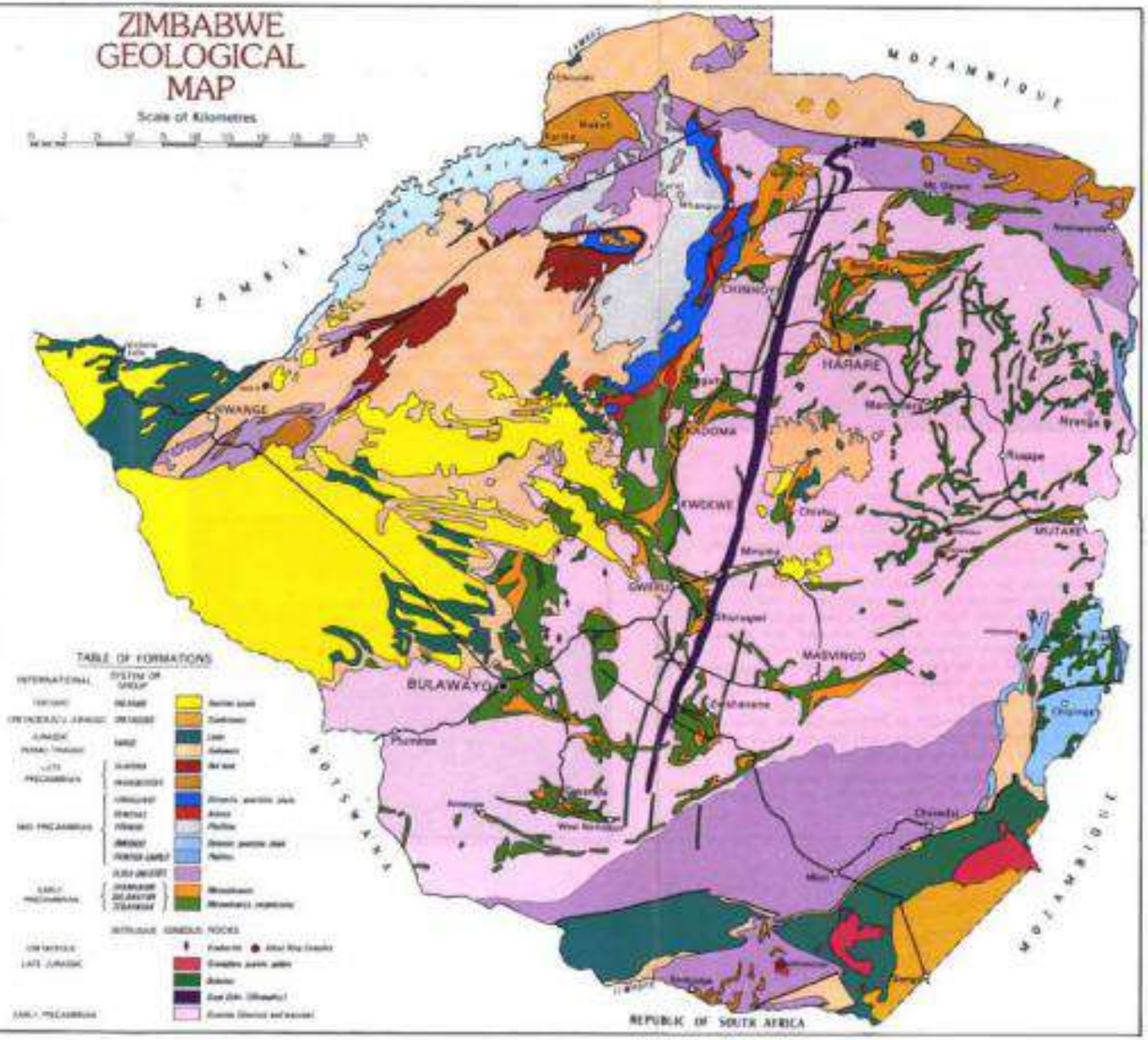
e.g. Mazowe River

4. Un resolved source in sedimentary basins

e.g. Tarka Forest, in Chimanimani/ Kadzi Conglomerates in Zambezi Valley

ZIMBABWE GEOLOGICAL MAP

Scale of Kilometres



Residual placer gold mining, Angwa River, Two Tree Estate, Zimbabwe

(Discovered by Vertical Investmenst P/L in mid 1990s)

Residual placer gold mining, Angwa River, Zimbabwe

Processing residual placer gold mining, Angwa River, Zimbabwe

Some company mining alluvial gold illegally along the banks of Angwa River, in 2014

Road made parallel the river

Mining in the riverbed

Mining in the riverbed

Scooped riverbank

Gold wash plant

DTZ-OZGEO (Pvt) Ltd

Building Zimbabwe through unique alluvial gold and diamond mining methods.

DTZ – OZGEO (Pvt) Ltd

Overview

- DTZ-OZGEO (Private) Limited was a joint-venture mining company established in 1994 with initiative of the Late Vice President Dr Joshua Nkomo. The invitation was based on vast experience of Russian Companies in alluvial mining and was made in view of the wide spread panning as a way to combat land degradation through implementation of environmentally friendly exploration and mining methods and land reclamation.
- The company was jointly owned by the Development Trust of Zimbabwe and a Russian company, Ozgeo.
- The company is so far one of the major contributors to the Zimbabwe-Russia bilateral trade.
- The company's vision was to transform the nation's natural resources into wealth and in so doing contribute in the country's economic growth and prosperity.

Introduction

- **DTZ-OZGEO (Private) Limited** was one of the most capable and leading alluvial mining companies in Zimbabwe. Its expertise in alluvial minerals included the entire spectrum of project disciplines from feasibility studies, infrastructural and plant design, mine operations and land reclamation. The company had the experience and knowledge that allowed it to design and develop varied and multiple stage washing plants, ranging from gravity or pump fed DMS cyclone plants, spiral plants etc. The company was a leader in alluvial mineral mining in Zimbabwe.
- The strength of the company was in its experienced staff which comprised a geological department, environment management and mining engineers. The staff has more than 150 years of combined experience in mining activities.
- Mining operations of the company were based in the Manicaland Province of Zimbabwe and comprise of an alluvial gold mine in Penhalonga and diamond mine in Chimanimani.

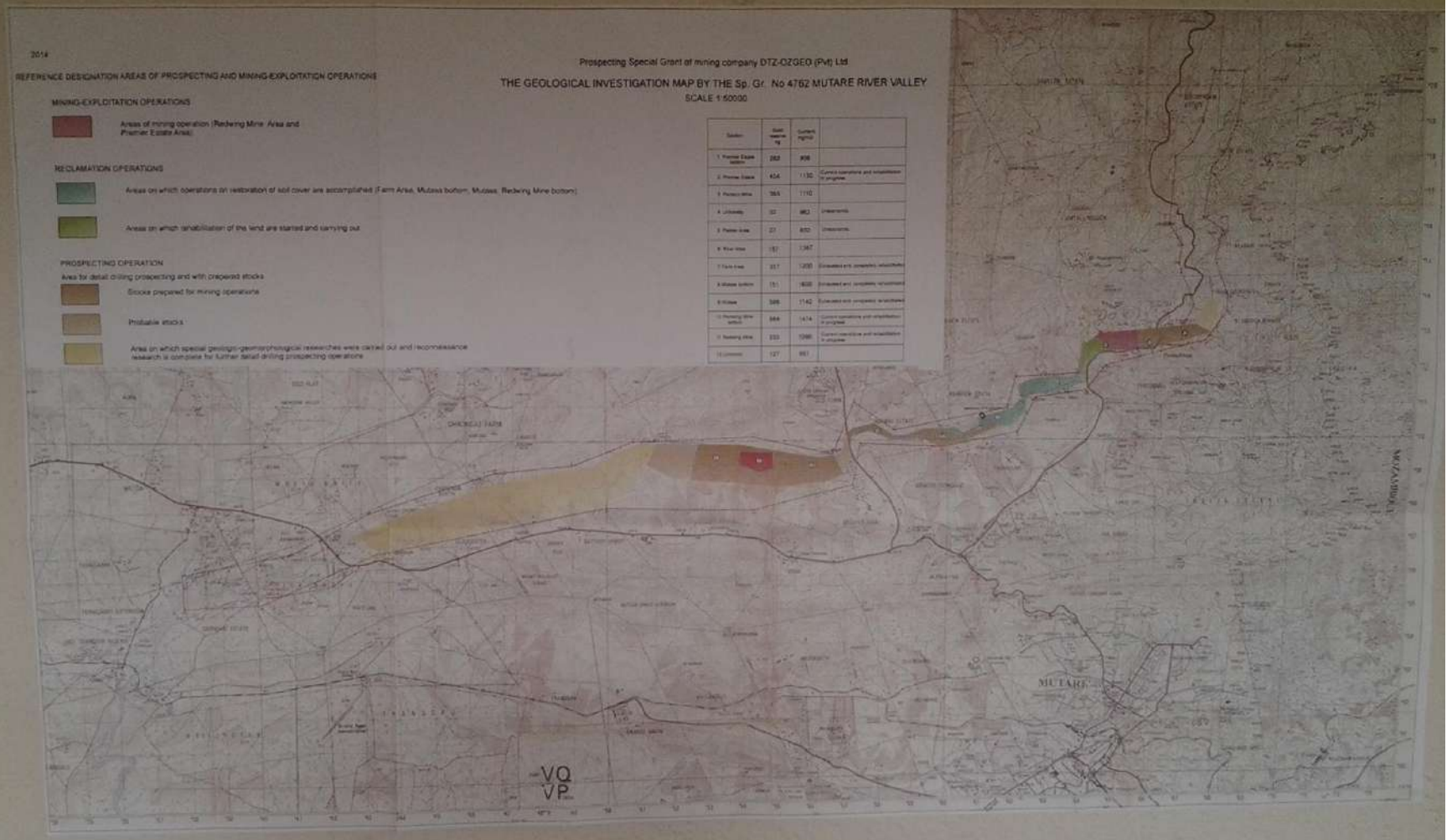
Exploration

- The company had several exploration projects around the country including in Mutare and Chimanimani-Save mineral provinces.
- **Types of geological work carried out:**
  - Area selection
  - Interpretation of aerial and remote sensing images
  - Geological and geomorphological mapping
  - Pitting and trenching
  - Sampling and laboratory analysis of geological samples
  - Geophysical & geochemical mapping
  - Exploration drilling

Drill rig used in exploratory drilling

RAB drilling up to 24m deep

Drill rig (20cm diameter)used in exploration drilling


2014
REFERENCE DESIGNATION AREAS OF PROSPECTING AND MINING-EXPLOITATION OPERATIONS
MINING-EXPLOITATION OPERATIONS
Areas of mining operation (Redwing Mine Area and Premier Estate Area)
RECLAMATION OPERATIONS
Areas on which operations on restoration of soil cover are accomplished (Farm Area, Mutasa bottom, Mutasa, Redwing Mine bottom)
Areas on which rehabilitation of the land are started and carrying out
PROSPECTING OPERATION
Area for detail drilling prospecting and with prepared stocks
Stocks prepared for mining operations
Probable stocks
Area on which special geologic-geomorphological researches were carried out and reconnaissance research is complete for further detail drilling prospecting operations
Prospecting Special Grant of mining company DTZ-OZGEO (Pvt) Ltd
THE GEOLOGICAL INVESTIGATION MAP BY THE Sp. Gr. No 4762 MUTARE RIVER VALLEY
SCALE 1:50000
MUTARE
VQ
VP

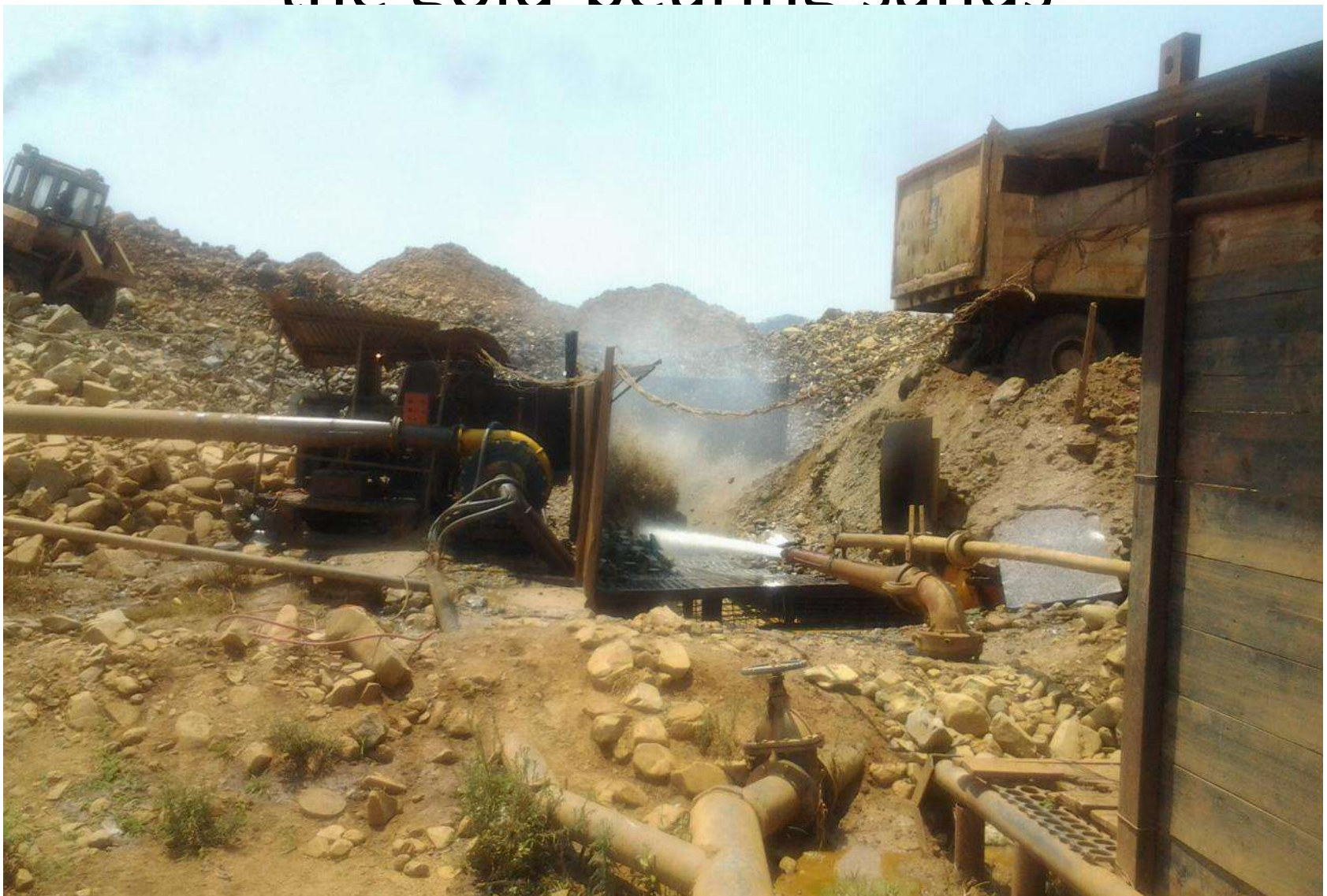
Stripping of overburden

Wash Plant used in gold processing

Sluice sited 200-300m away from the current river channel

High pressure water gun used in washing the gold-bearing sands

High pressure water gun used in washing the gold-bearing sands



Gold nuggets from Penhalonga, Mutare River

Land Rehabilitation

- **Sustainable land rehabilitation prioritised at DTZ-OZGEO**
- Mined out areas were backfilled in reverse sequence as per soil profile to ensure the fertile soil is returned on top.
- Backfilled areas were then re-vegetated with expert advise from consultants and Agritex.
- A nursery of indigenous trees and grasses was maintained.
- Rehabilitated areas by 2013 were Fairview Farm, State land and Mutasa Farm.
- Rehabilitation at Redwing and Premier Estate mining sites was not cmpleted due to the pre-mature suspension of mining operations.

Final stages of rehabilitation, contouring to avoid soil erosion

(old river channel mined upto 200-300m from the river)

Nursery to facilitate revegetation

and after rehabilitation was subjected to farming

Site where the wash plant was shown above

Placer gold of yet unconfirmed sources?

1. Gold in conglomerates in the Zambezi Valley

2. Gold in the Umkondo Sedimentary Basin of Chimanmani.

Part of the map showing the Kadzi Conglomerate in the Zambezi Valley

(Map Zimbabwe Geological Survey Bulletin 96, Hahn et al, 1986-89)

Sampling in Guruve West

Sampling in Guruve West

Placer Gold in Tarka Forest Chimanimani, Eastern Zimbabwe

Background

- There was a boom in alluvial gold mining when panners stormed Tarka Forest in 2004.
- Gold sold to Fidelity Printers and Refineries of the Reserve Bank ranged between 80-100kg per month, exceeding production from the largest gold producers then.
- Notably, the gold is hosted in alluvia above the dolerite bedrocks.

Gold panning in Tarka Forest

Soils above dolerite

Gold panning in Tarka Forest

Soils above dolerite

Gold panning in Tarka Forest

Typical gold nuggets

Exploration

- In 2015 DTZ-OZGEO conducted reconnaisance exploration for a client in Tarka Forest.

It used 3 types of conceptual models:

- Tarka Forest type placer gold mineralization above the dolerite sill.
- Possible hydrothermal gold deposits.
- Possible conglomerate gold of the Witwatersrand-type of South Arica, basing on it's conglomerate diamond deposit just north of Tarka Forest.

However, the work was not completed due to lack of funding.

Bulk sampling

Overal conclusion

The examples of placer deposits in Zimbabwe presented suugest:

- A wide diversity of placer formation models and types.
- The 500m buffer from the current river excludes fluvial recent gold meanders, old river channels and potholes close to the current river channel.
- The 30m buffer from the centre of the river channel in Statutory Instrument 12 of 1990, is inadequate as well.
- There are possible huge deposts in sedimentary basins such as Umkondo and the Zambezi Valley that can only be explored under titles such as Exclusve Prospectng Orders or large Special Grants which ultimately, require longer exploration tenure as other deposit-types.
- There appears, to be no one sze fit all for the size and tenure of the exploration ground for placer deposits, calling for a dynamic flexible approach worldwide.
- Therefore, the emphisaged model for the formation or accumulation site should dictate the parameters of the exploration ground.

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THANK YOU