Placer Deposits

OCN 631/ORE 678

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Placers Outline

- Placer Deposit Types
- Environments of Placer Mineral Occurrence
- Exploration Methods in Shallow Waters
- Sand & Gravel, Mineral Aggregates
  - Sources and Uses of Major US Nonmetallic Construction Raw Materials
  - Projected US Sand & Gravel Demand
  - Sources & Fates of Offshore Sand & Gravel Deposits
- Exploitation (Mining) Methods
  - Dislodgement Needs for Mining Marine Minerals
  - Depth of Marine Minerals & Equipment Capability
- Marine Diamond Exploration & Mining Areas of Southern Africa

Target Commodities

Source: IHC Deep Sea Dredging & Mining

IHC Deep Sea Dredging & Mining

Dredging technology has been expanding its horizons since the discovery of the treasures of the deep sea. Deep Sea Dredging or Mining is a greenfield activity since no proven technology is available for deep sea activities. A serious transition is needed in order to develop new excavation techniques and vertical transport systems for deep sea activities. The main challenges are the hyperbaric conditions, the slurry transport, the remote control and maintenance aspects.

Placer Deposit Types

From: D. S. Cronan,
Underwater Minerals (1980)

Table 1. Examples of placers, aggregates and other minerals.

Commodity	Ore mineral	Specific gra
Non-metallic		
Silica	quartz sand	2·65
Lime	shells and shell sands	2·7
Sand and gravel	various	3·0
Topaz	topaz	3·4–3·6
Spinel	spinel	3·5–4·0
Corundum	corundum	3·9–4·1
Heavy mineral sands		
Beryllium	beryl	2·75–2·8
Titanium	rutile	4·18–4·25
Titanium	ilmenite	4·7
Chromium	chromite	4·6
Zirconium	zircon	4·68
Manganese	hausmannite	4·72–4·84
Manganese	braunite	4·72–4·83
Iron	magnetite	5·18
Thorium	monazite	5·0–5·3
Nb, Ta	columbite, tantalite	5·2–7·9
Rare-Earths	group of 15 REE oxides	
Tin	cassiterite	6·8–7·1
Mercury	cinnabar	8·10
Precious and rare		
Diamond	diamond	3·5
Copper	native metal	8·9
Silver	native metal	10·5
Gold	native metal	15–19·3
Platinum	native metal	14–19

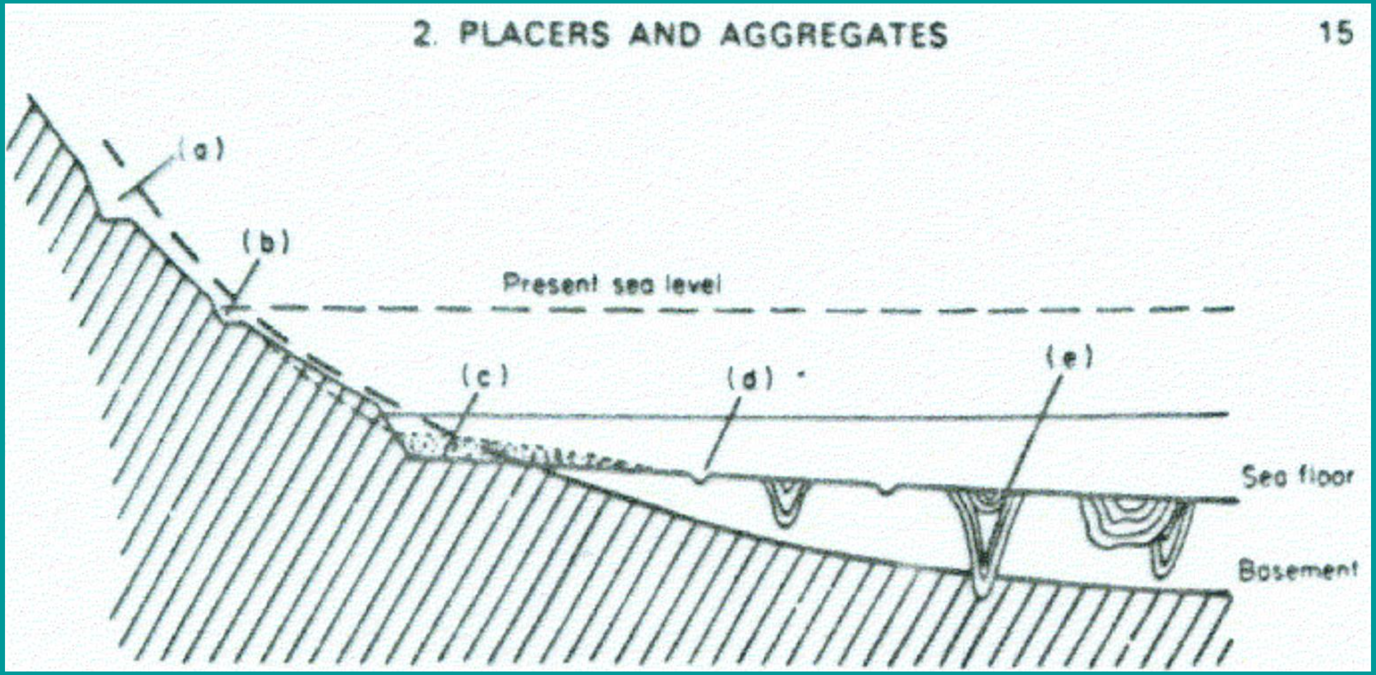
Hot Industrial Metal

Future Energy, High-Tech Metals

Industrial, Economic

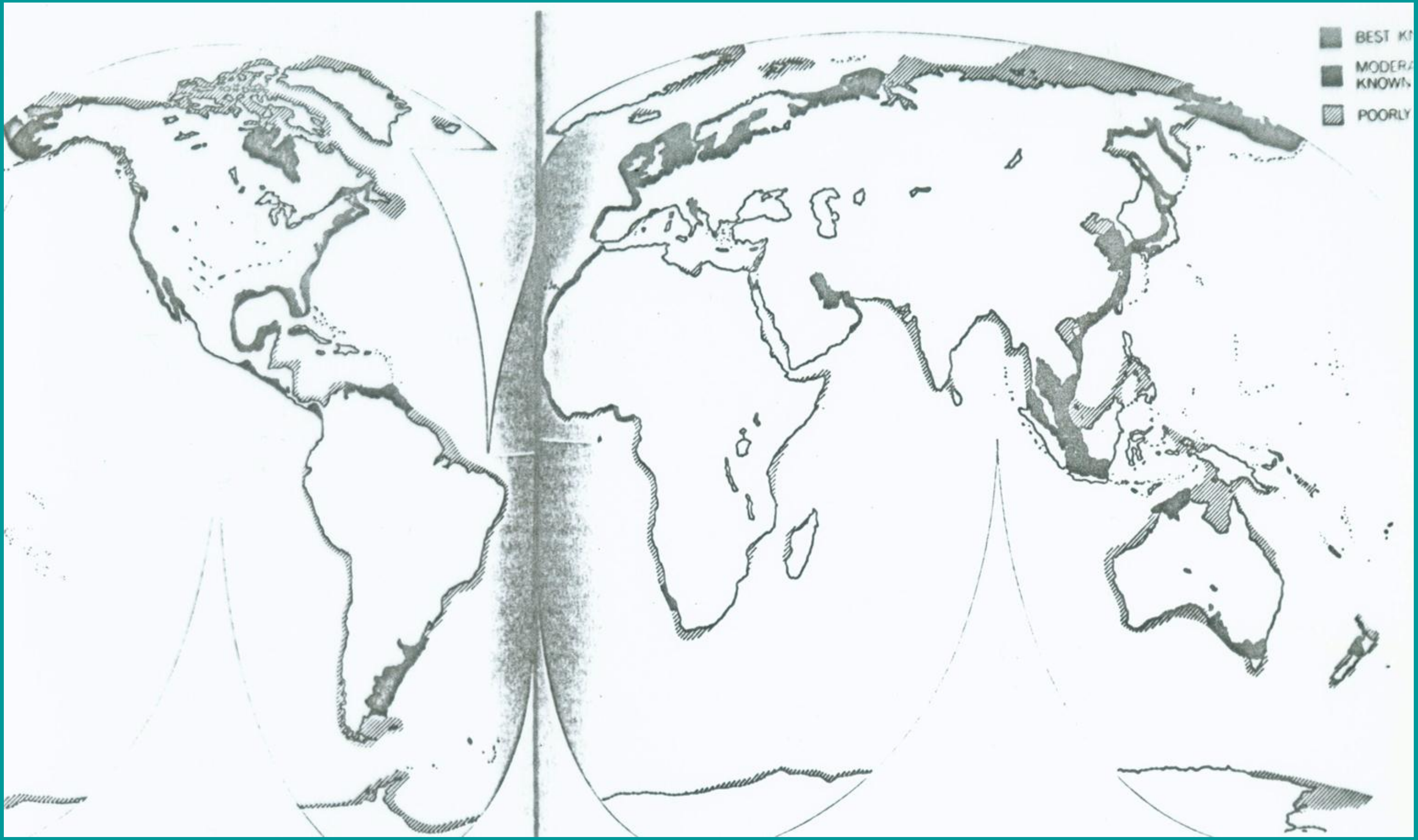
Where Specific Gravity = Density relative to H_2O (=1.00) in cgs units of g/cm^3

Environments of Possible Placer Mineral Occurrence

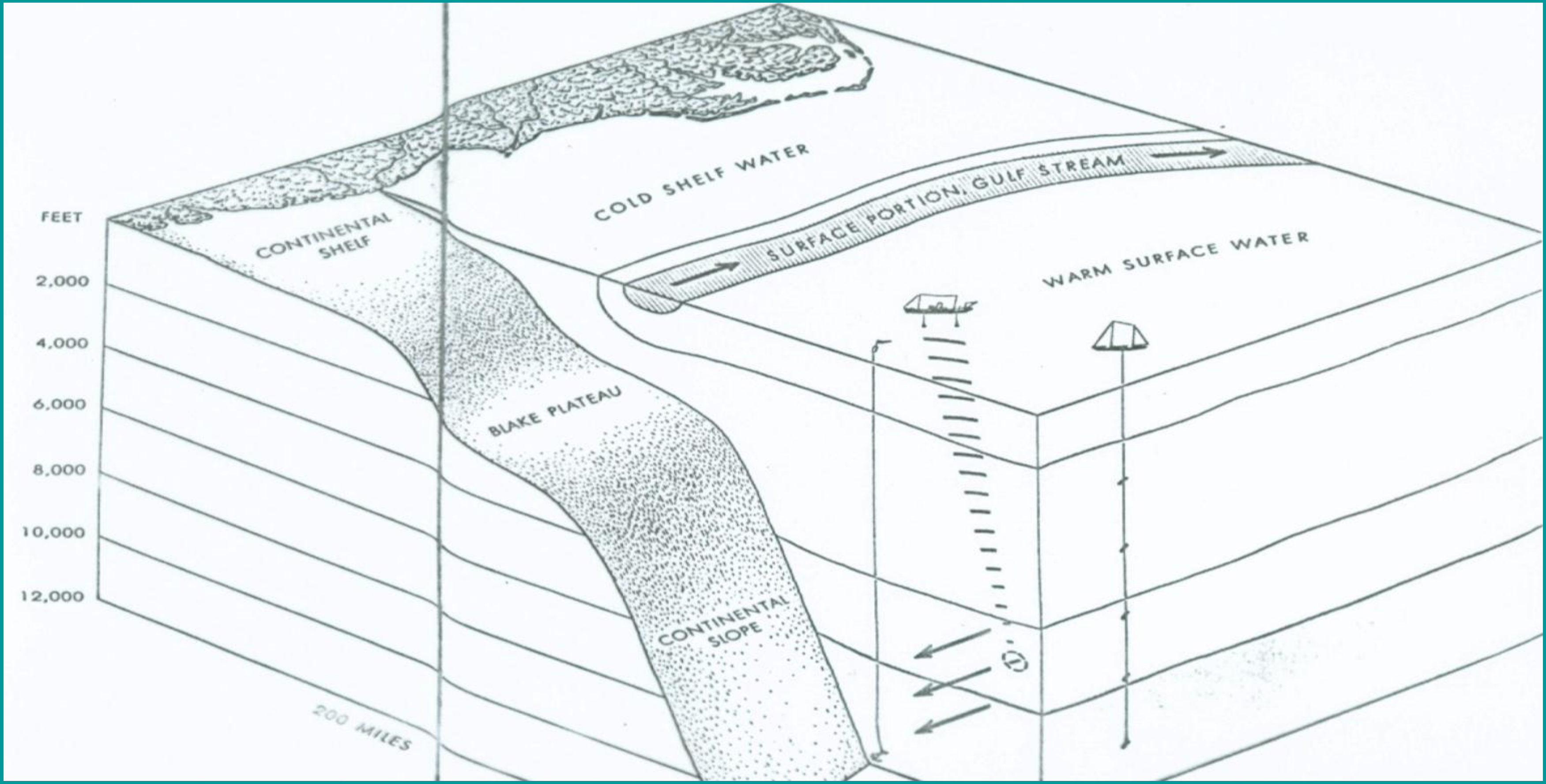


Cronan (1980)

Global Distribution of Continental Shelves, with Extent of Knowledge



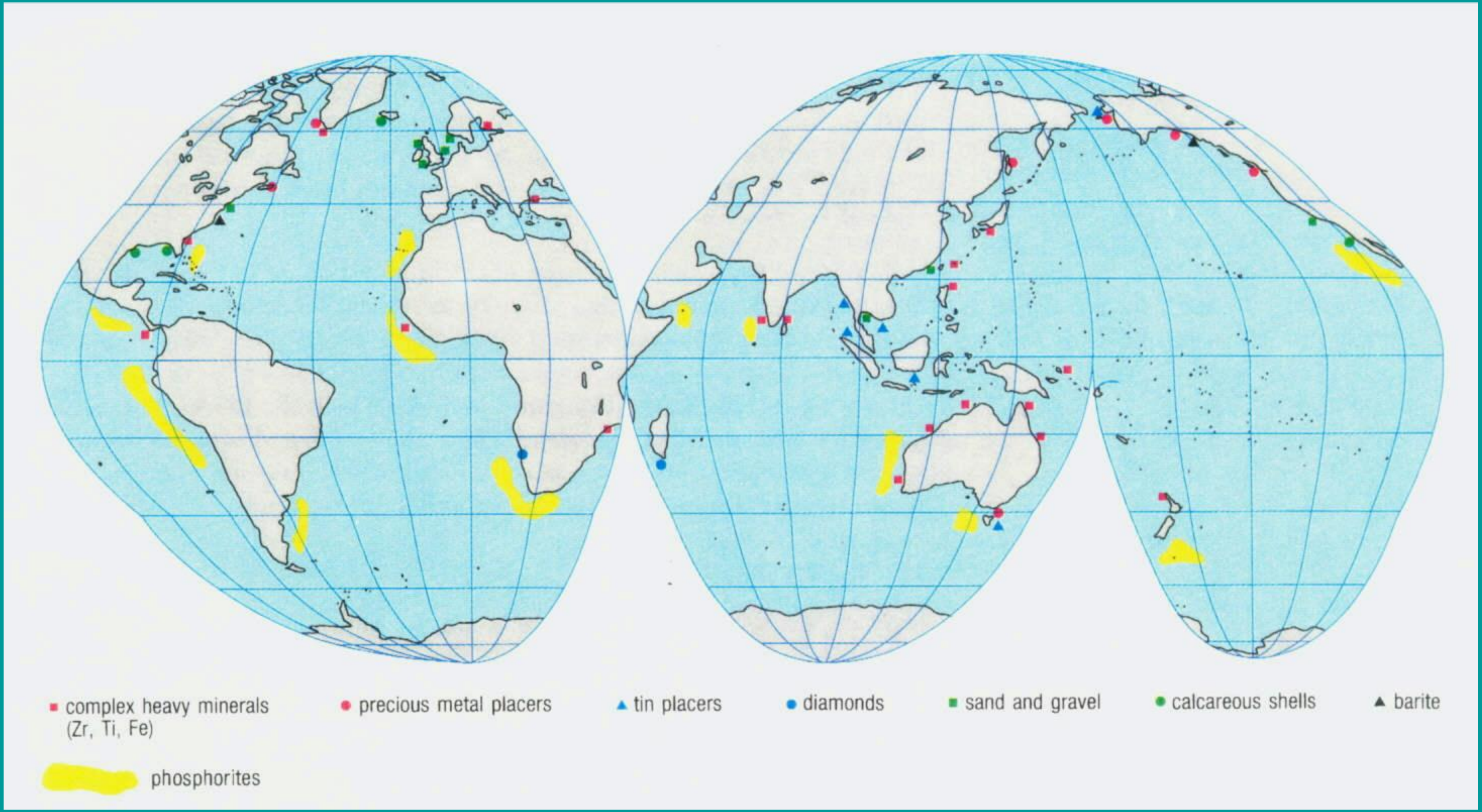
Continental Shelf and Slope off East Florida: The Blake Plateau



Global Distribution of Placer Deposits circa 1970

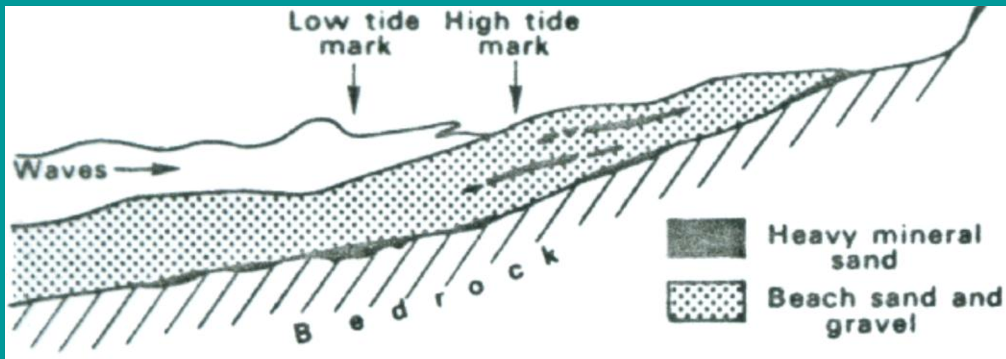
M = monazite (yielding U, Th)
D = diamonds

Earth's Future Resources: The Sea



Known global coastal distributions of phosphorites (P), heavy minerals, & various native metal & diamond placers (from US Minerals Management Service, 1990).

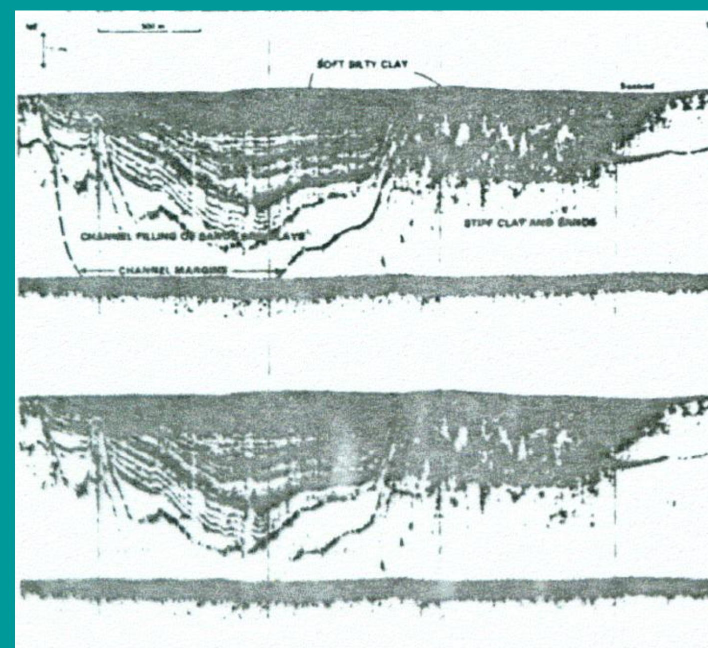
Exploration Methods in Shallow Waters



- SCUBA/NITROX Diving
- Sediment Sampling
- Geophysical Surveys
  ROV, AUV, shipboard

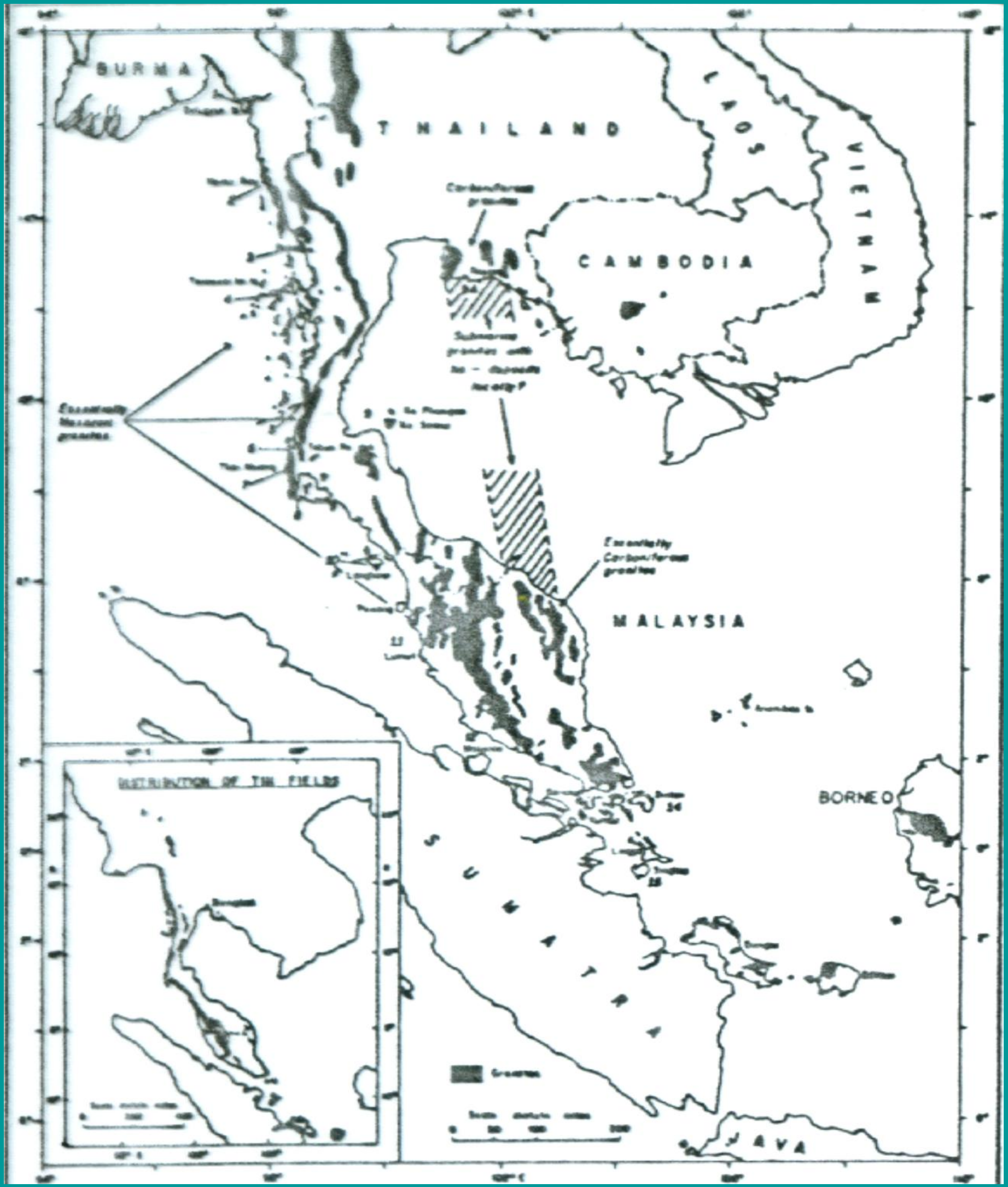
With contacts interpretation

Raw seismic



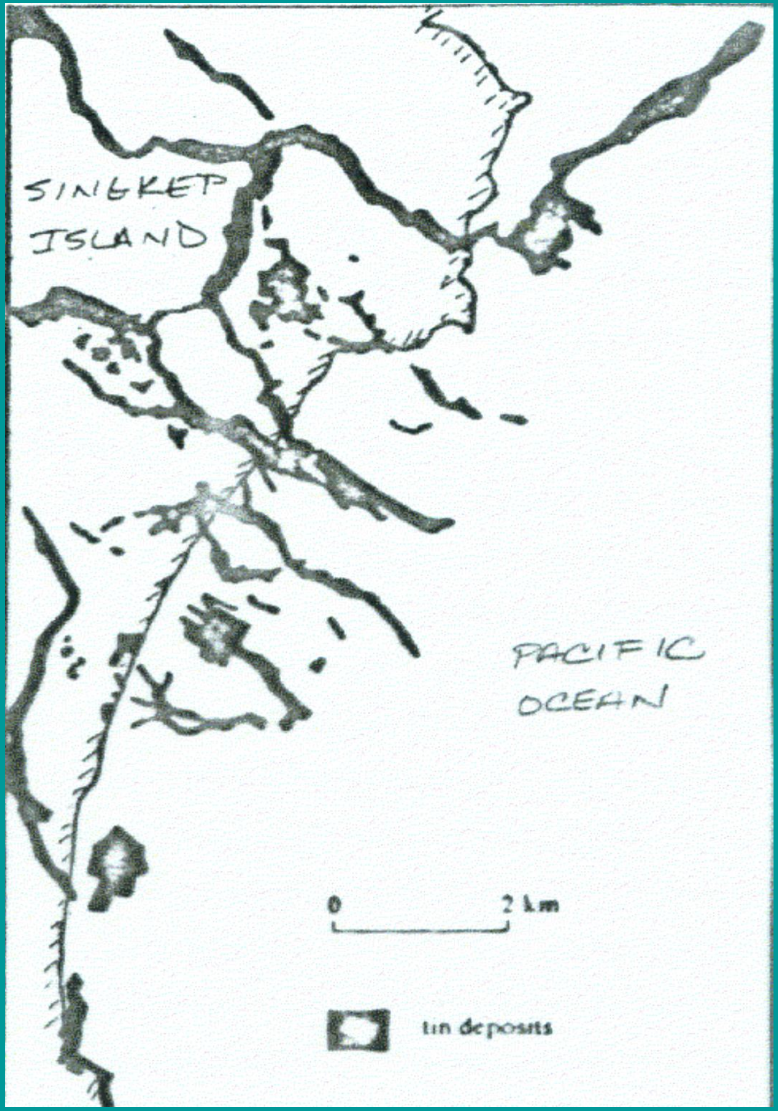
Example of Geology Leading to Possible Location of Tin (Sn, Cassiterite) Placers in Indochina (SE Asia)

Note location of “tin belts”, or SnO_2-bearing granites (source rocks) on land, and possible seaward extension into Gulf of Thailand



Seaward extension of cassiterite (SnO_2) placers formed in streams off Sinkep Island, Indonesia

Can you suggest a simple method of delineating potential areas of offshore placer deposits?

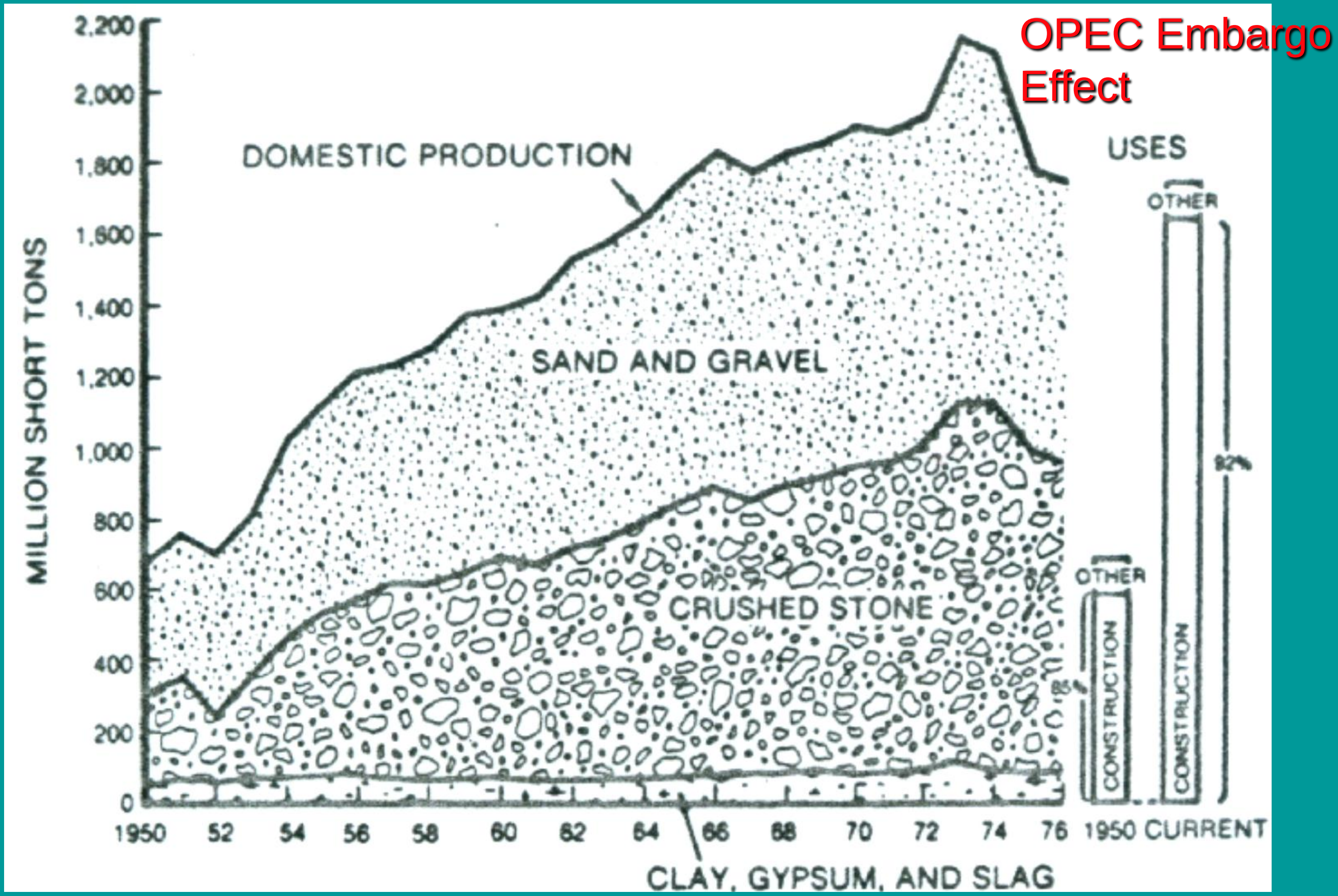


Consumption of mineral aggregates by the US construction industry, for the periods 1959 and 1972 (in millions of tons)

Construction use	1959 Sand	1959 Gravel	1959 Crushed stone	1972 Sand	1972 Gravel	1972 Crushed stone
Building	123	114		188	153	
Paving	105	313		131	280	
Fill[a]	16	17		49	43	
Railroad ballast	1	5		1	2	
Other	6	7		10	13	
Concrete aggregates						134
Bituminous aggregates						83
Macadam aggregates			357			33
Road-base aggregates						337
Surface treatment aggregates						52
Other						113
Total construction	250	456	357	378	492	752
Cement manufacture			91			109
Percentage of total production used in construction	92.9	98.9	12.2	92.8	97.3	81.6
Total production	269	461	582	408	506	922

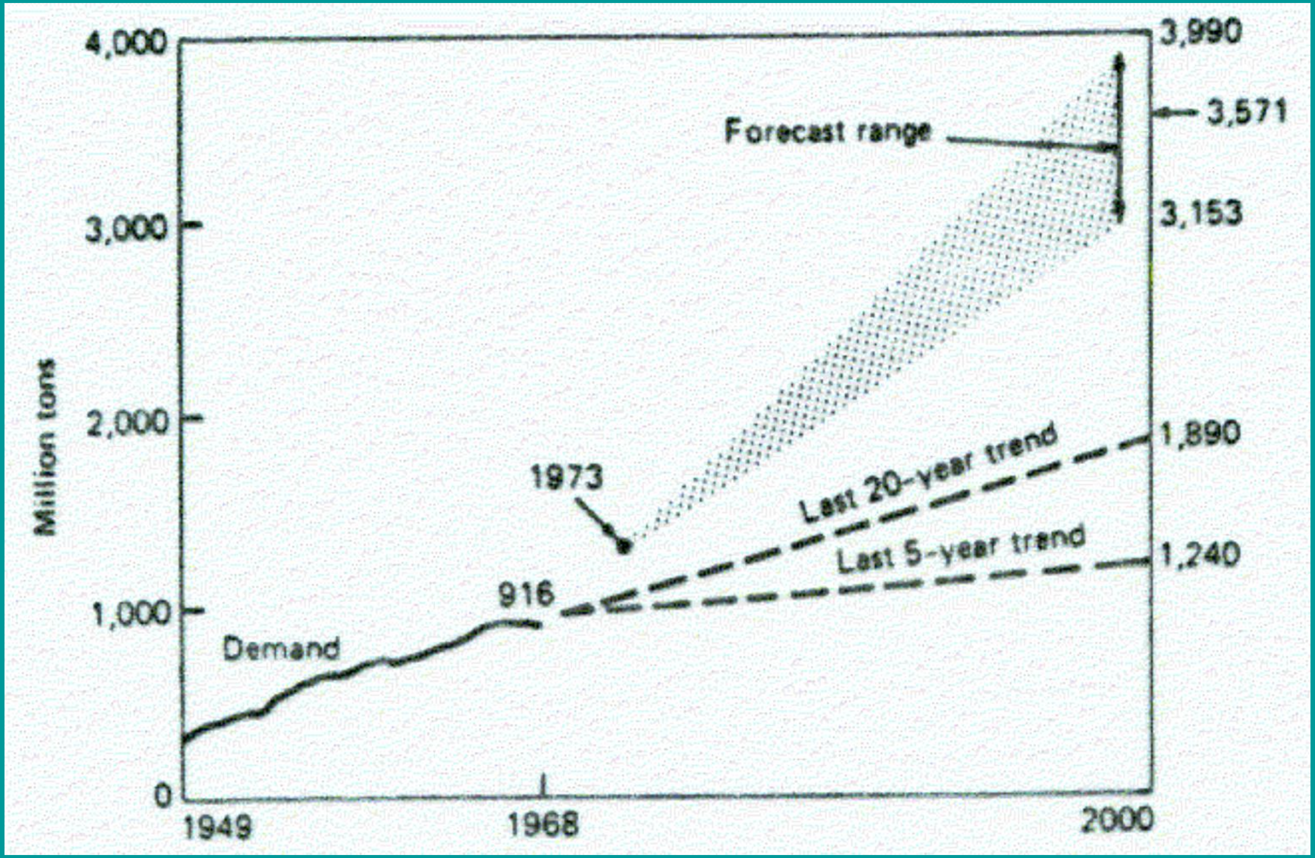
Source: Baram et al. (1978)

US Sources and Uses of Major Nonmetallic Construction Raw Materials



Source: Morgan (1973)

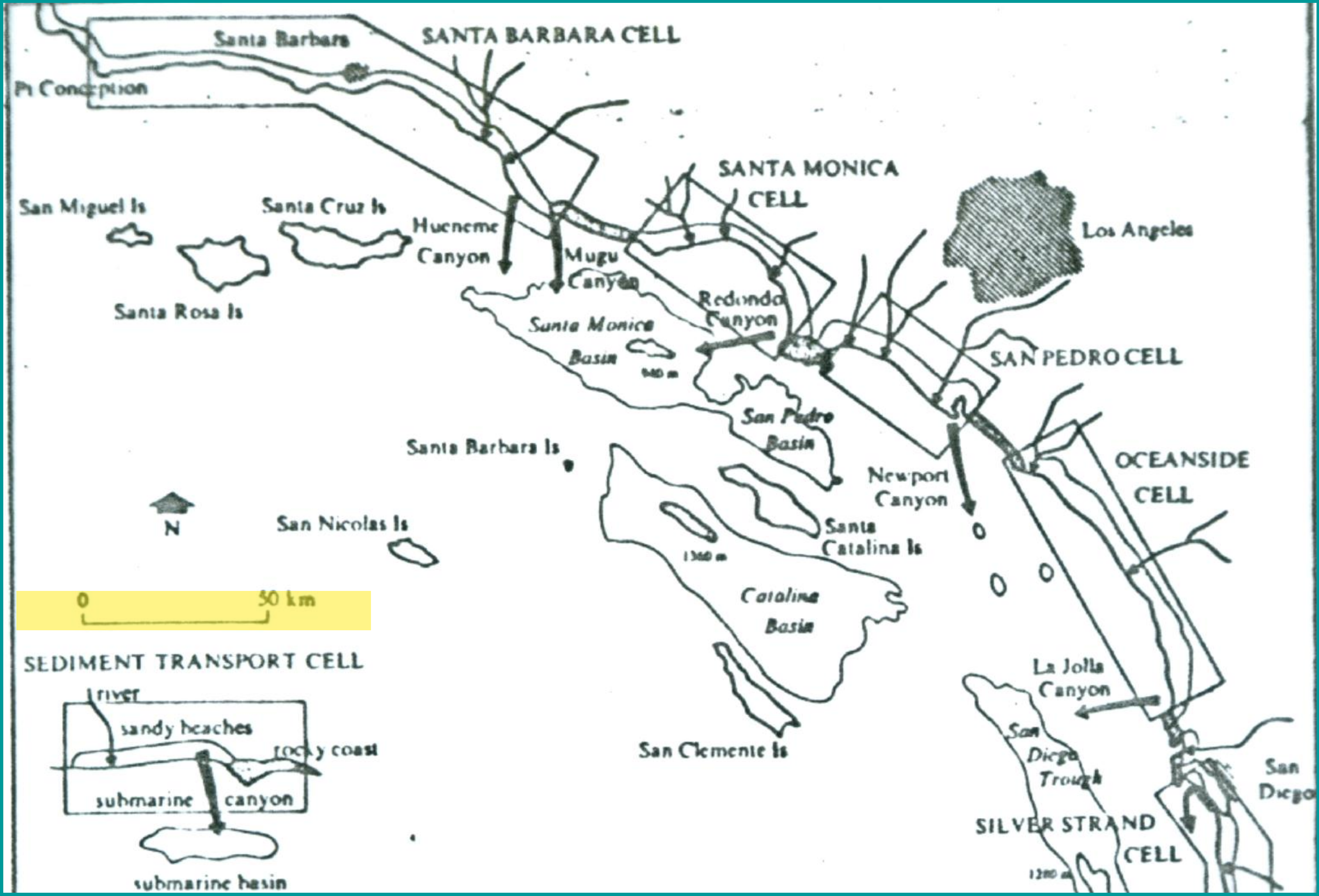
Projected US Sand & Gravel Demand



Source: Cooper (1972)

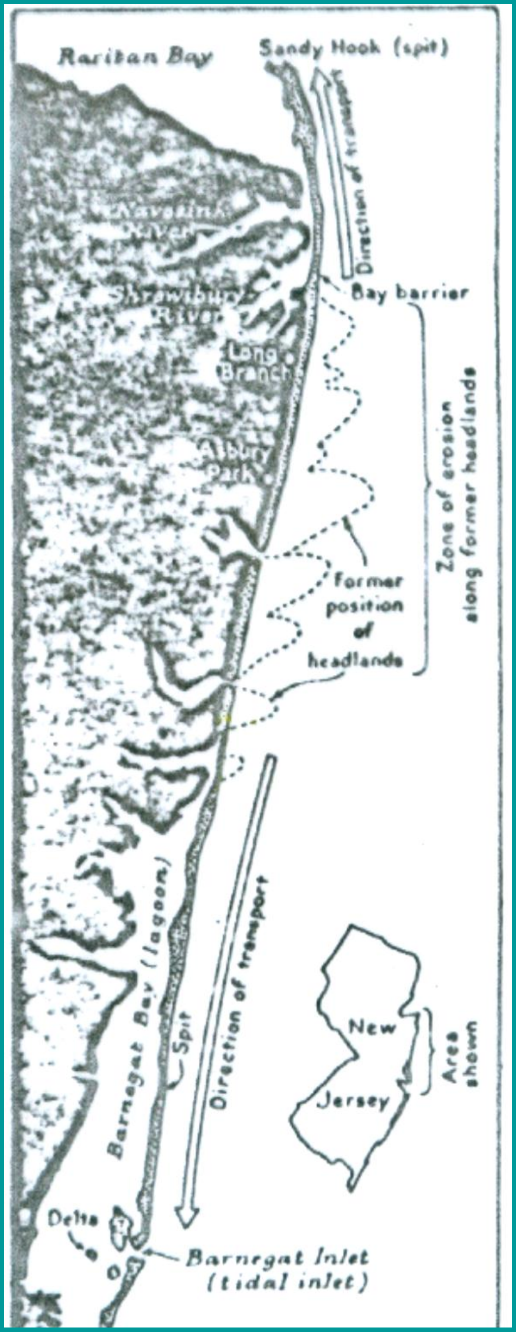
Which trend was correct?

Sources & Fates of Offshore Sand & Gravel Deposits: West Coast USA

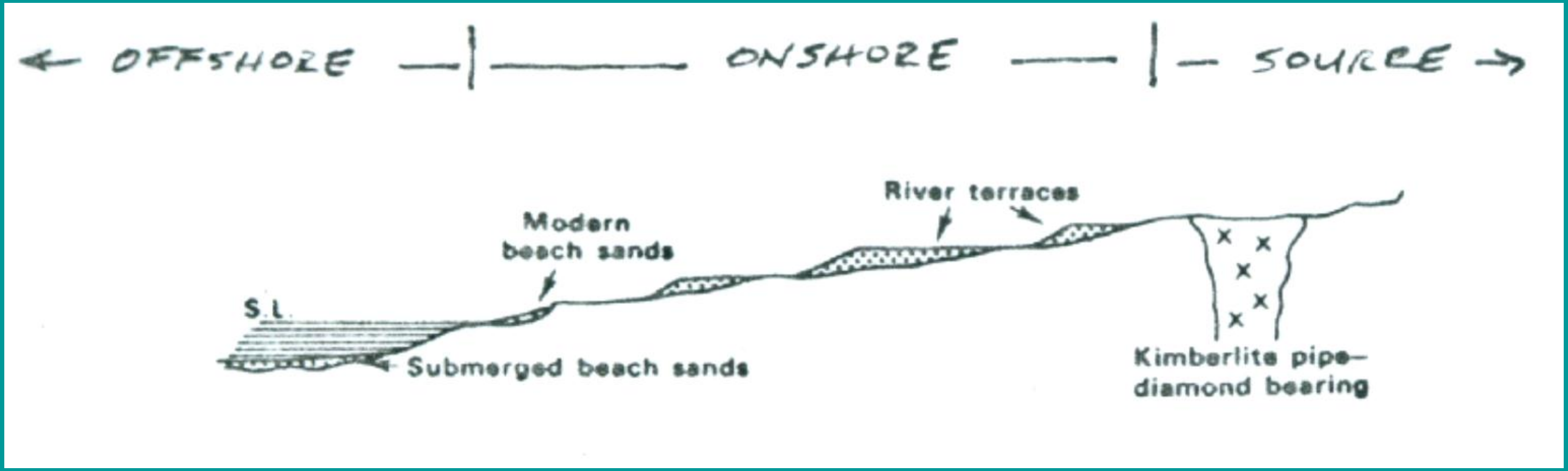


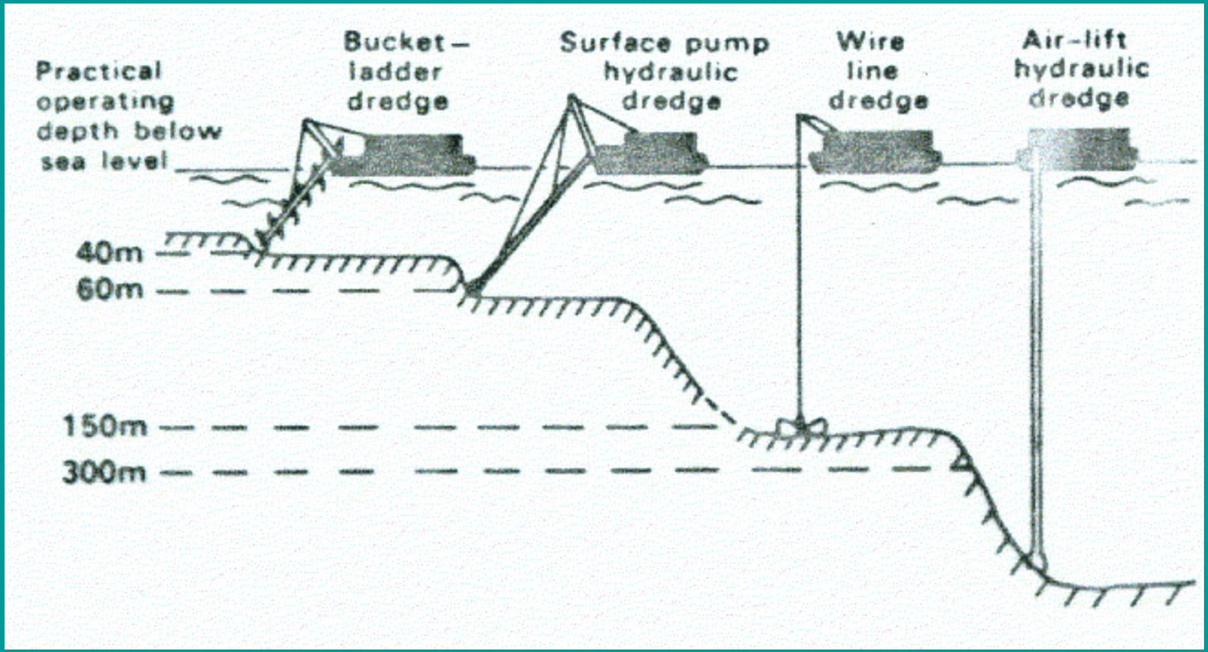
Sources & Fates of Offshore Sand & Gravel Deposits: East Coast USA

Note formation of longshore barrier islands from headland erosion



Placer Exploitation (Mining) Methods

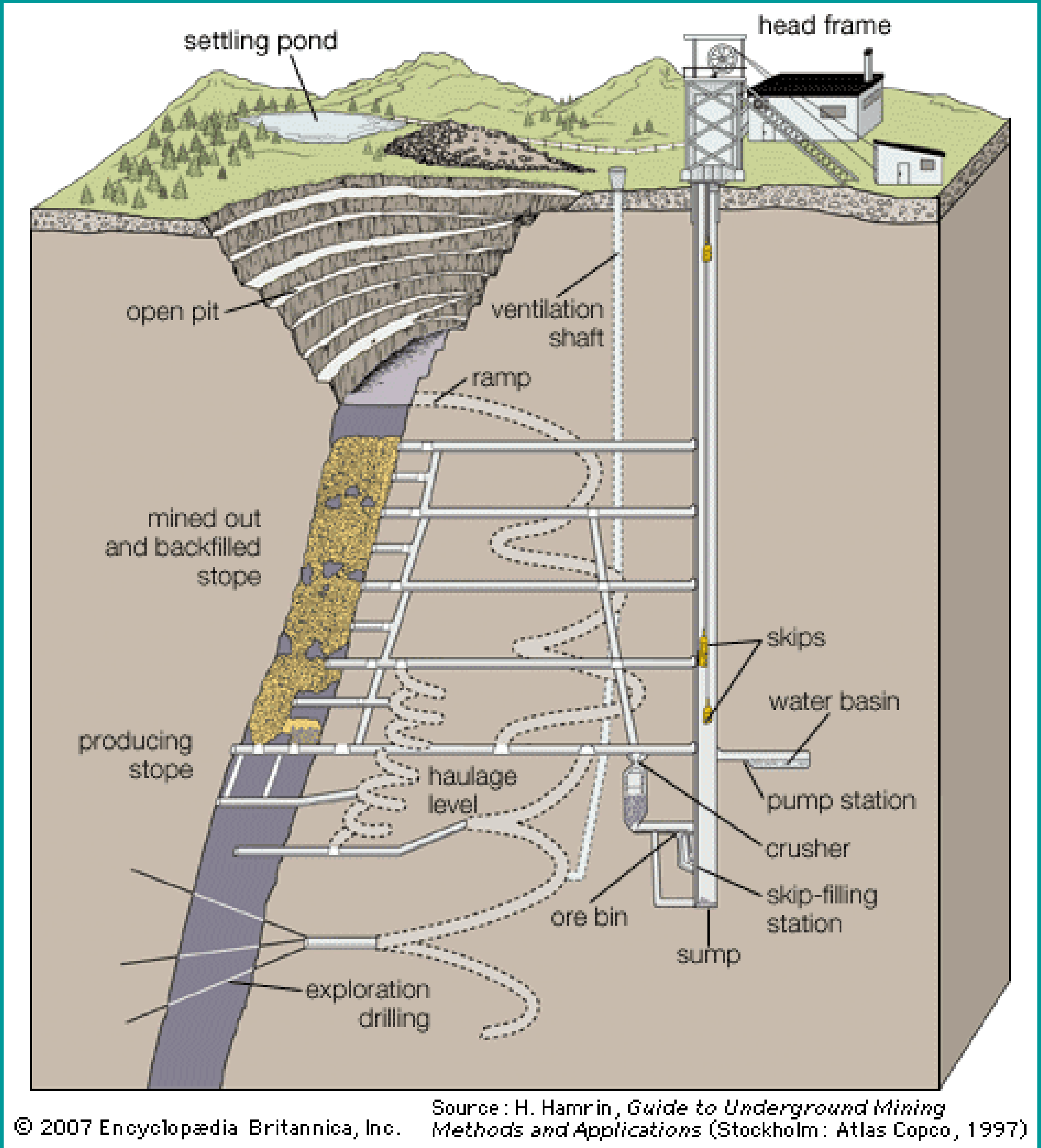




Dredging methods
at different water depths

Kent (1980)

Basic Mining Strategies & Techniques



Placer Mining on Land

Alluvial Diamond Mining, Africa

Open-Pit Iron Ore Mining, Brazil

Bolivian Tin Mine

Hydraulic Gold Mining, Alaska

Placer Mining at Sea

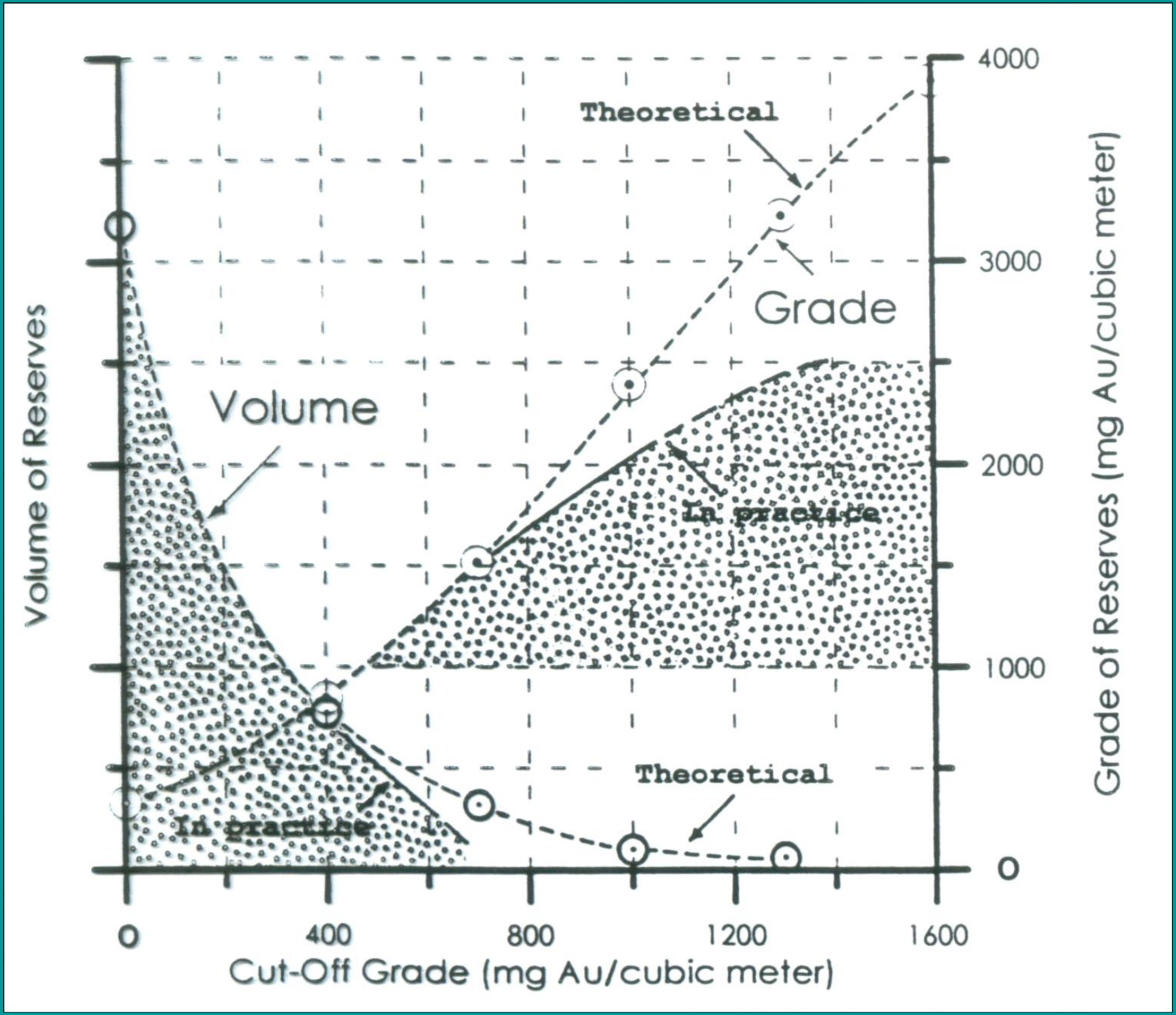
Source: IHC Deep Sea Dredging & Mining

Mining Industry Aspects

Source: IHC Deep Sea Dredging & Mining

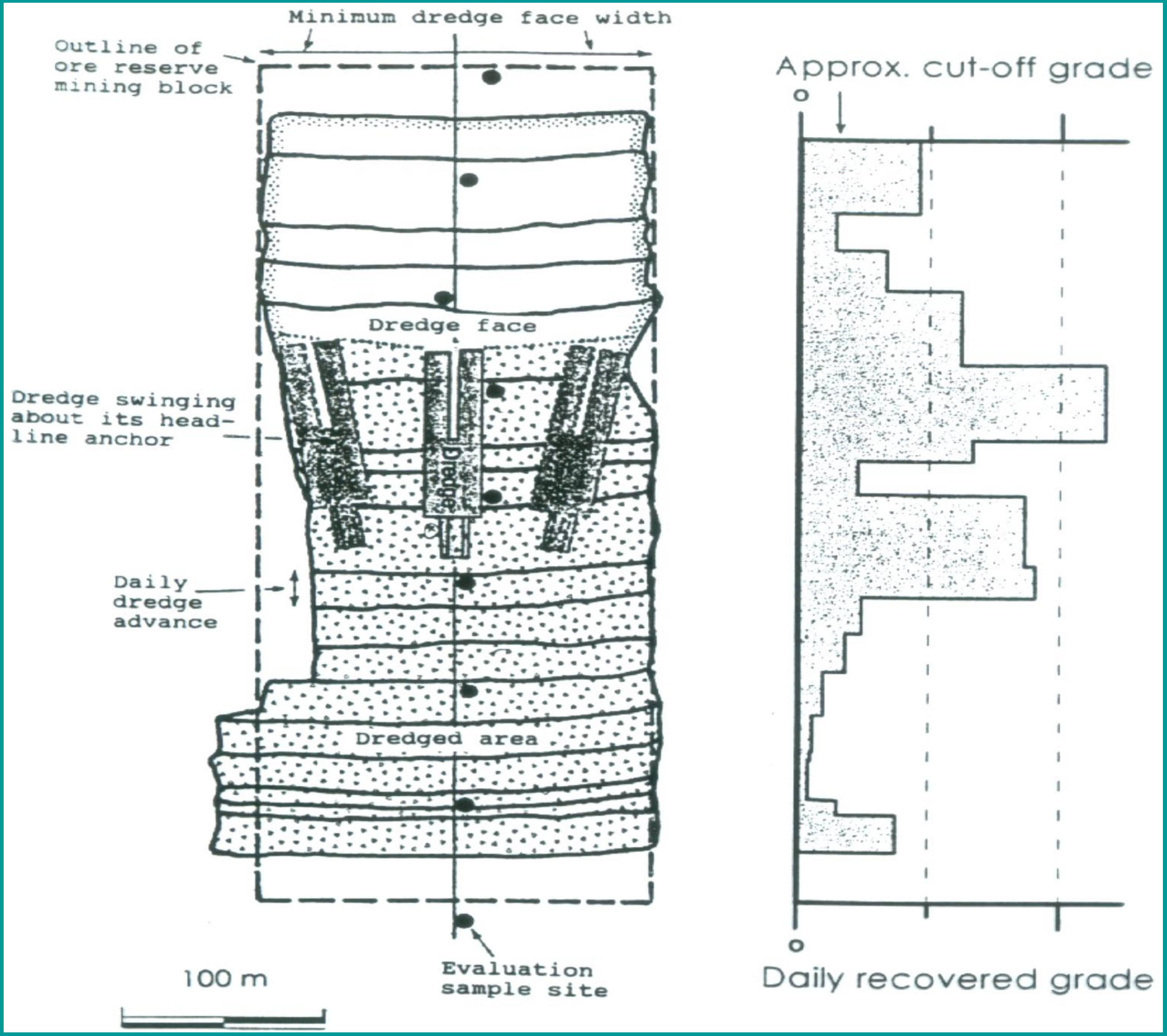
Grade-Volume Curve for Surficial Sediments of Nome, Alaska

Marine Placers

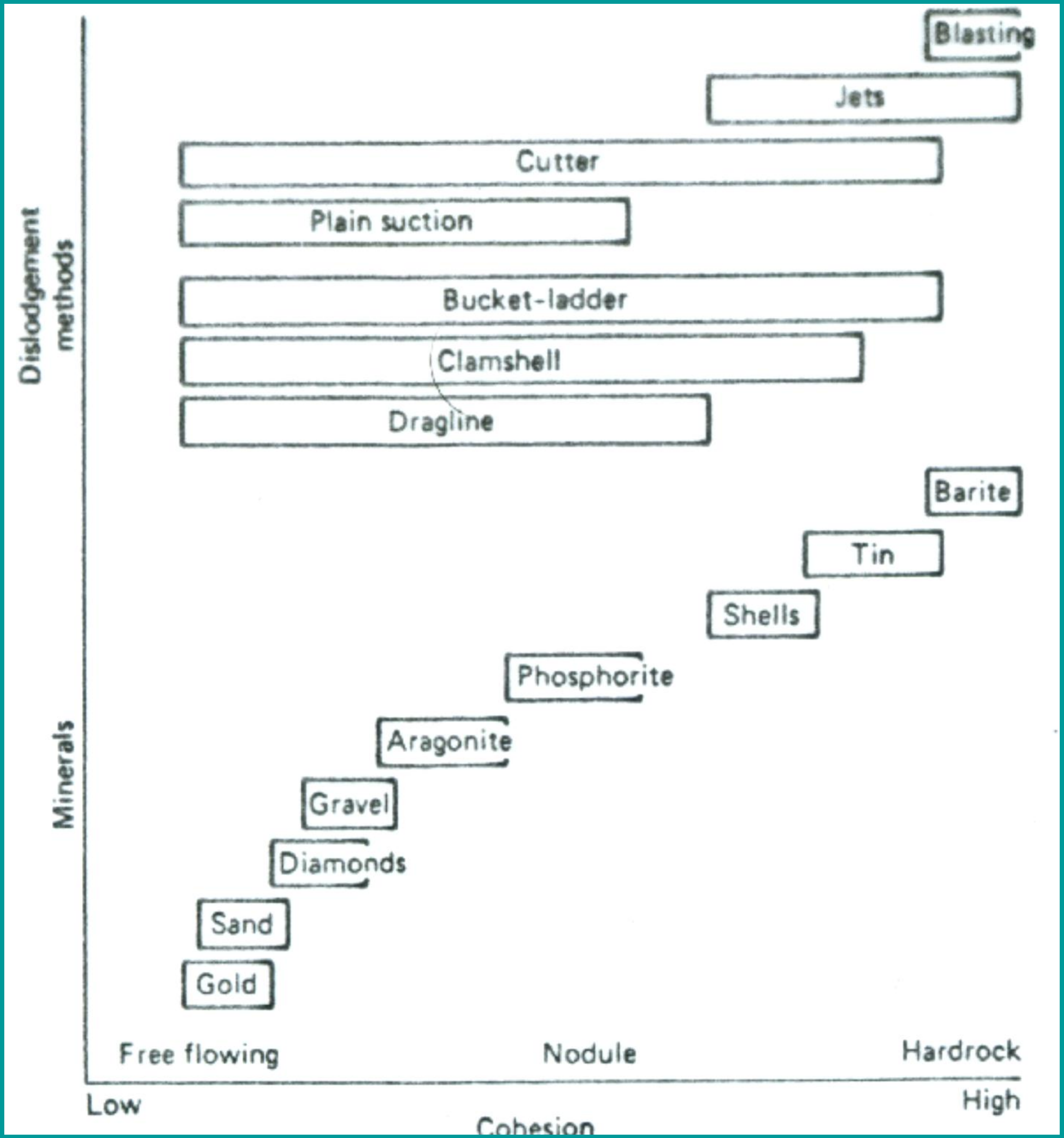


High Volume = Low Grade; High Grade = Low Volume!

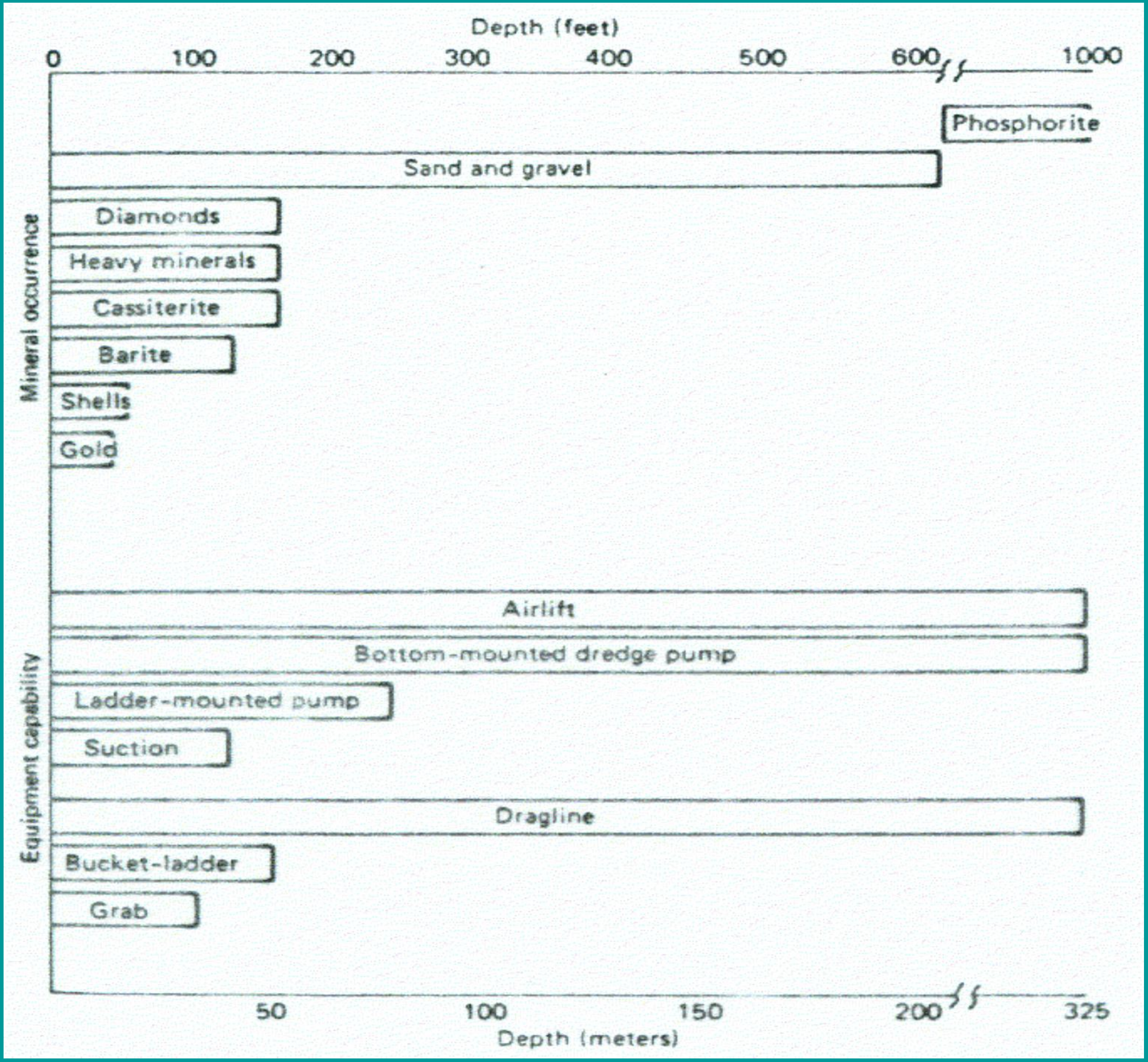
Progressive Dredging of a Reserve Block off Nome, Alaska



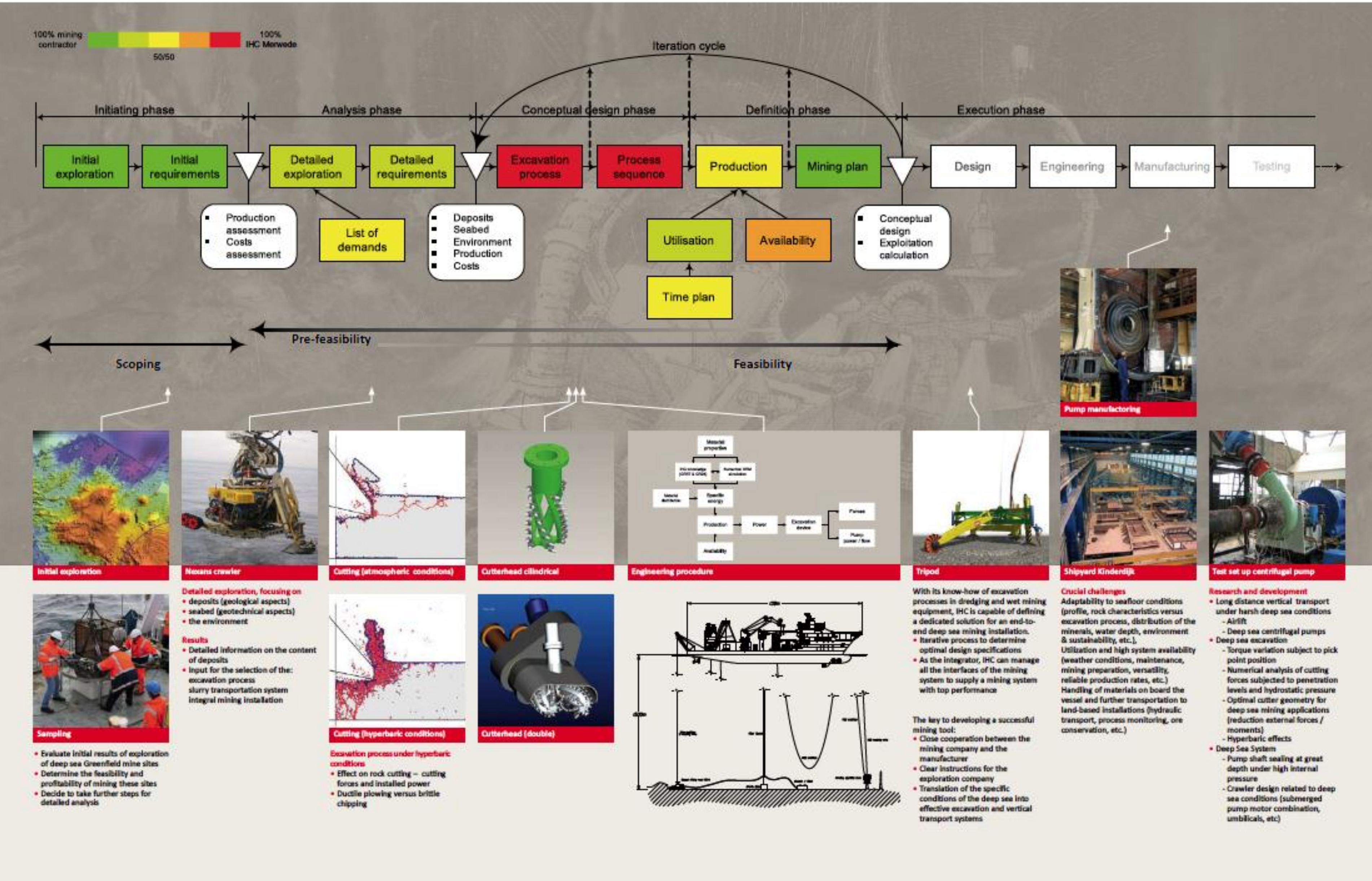
Dislodgement Needs for Mining Marine Minerals



Depth of Marine Minerals & Equipment Capability

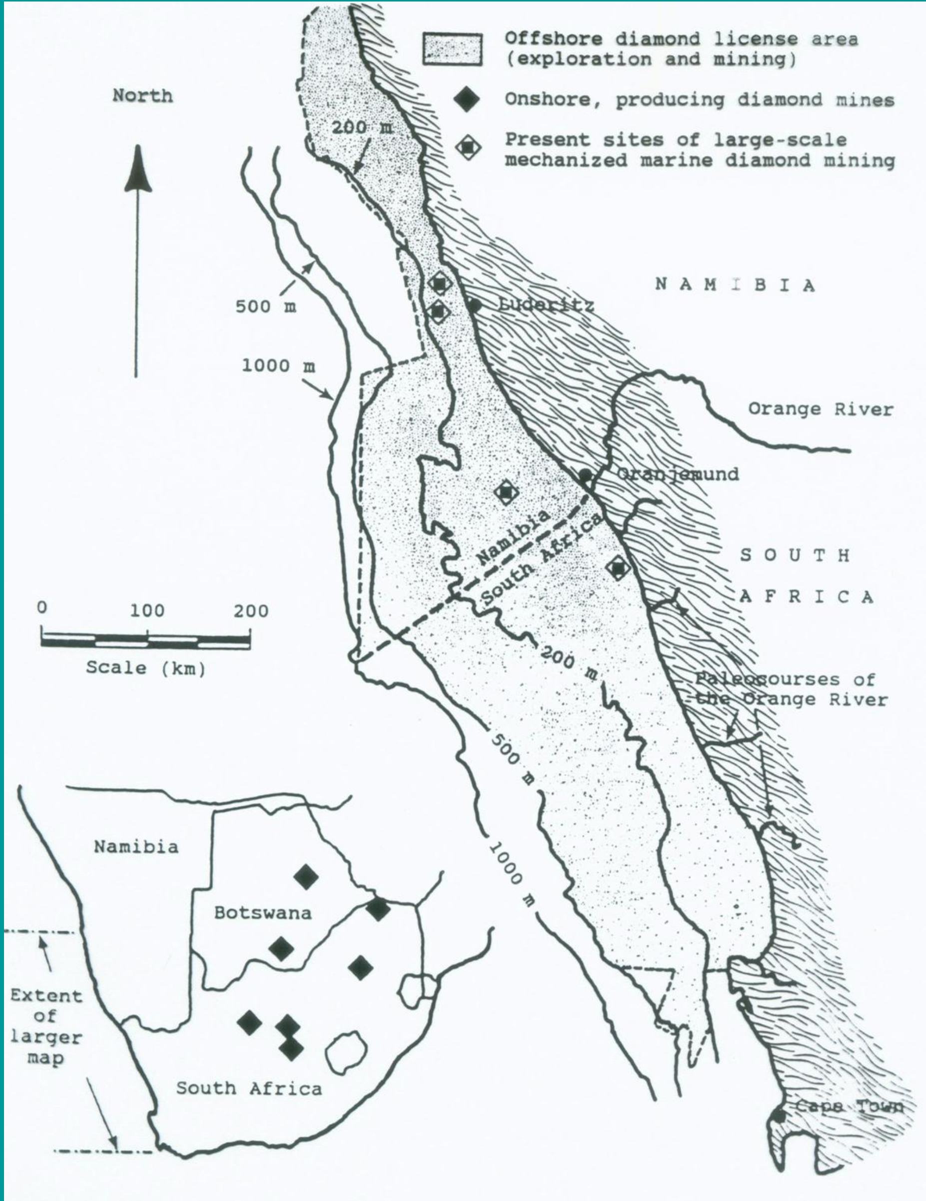


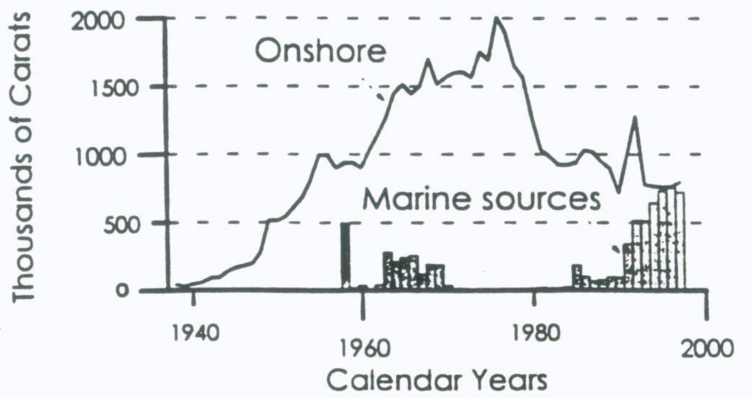
Project Development: From customers expectations to realization.



Source: IHC Deep Sea Dredging & Mining

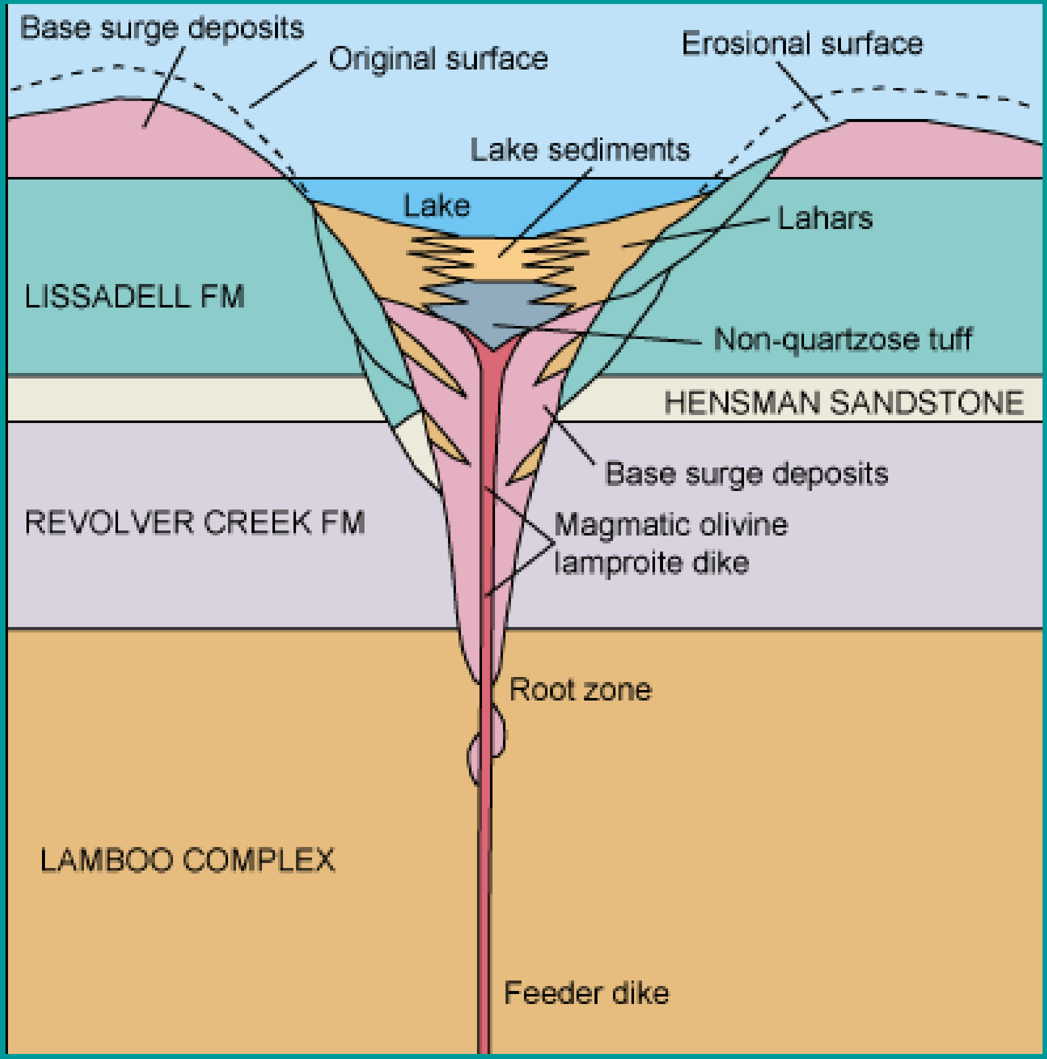
Marine Diamond Exploration & Mining Areas of Southern Africa





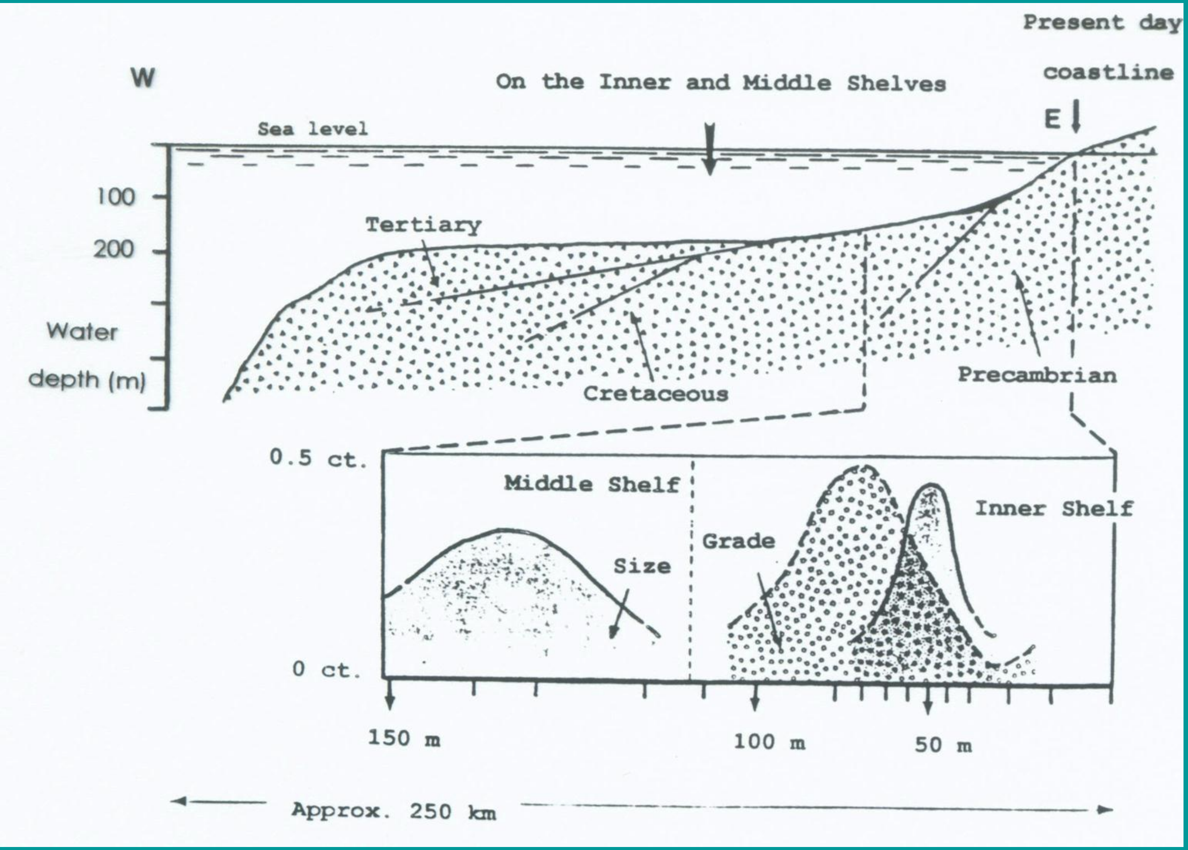
Historical annual diamond mining from Namibian sources

Diamond-bearing Igneous Pipes

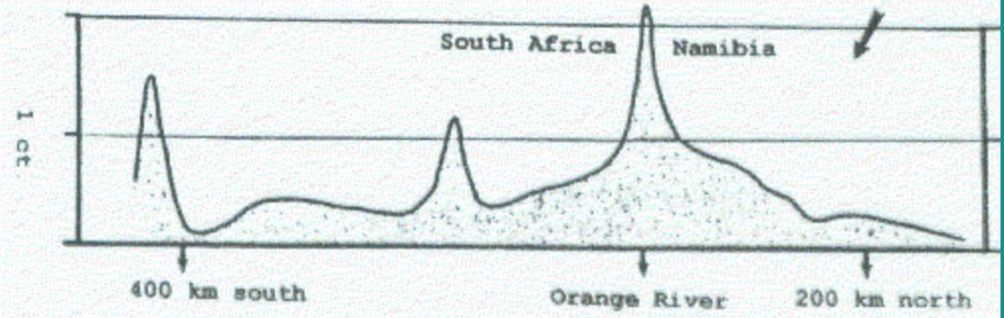


Interpretive section of a pipe in Australia

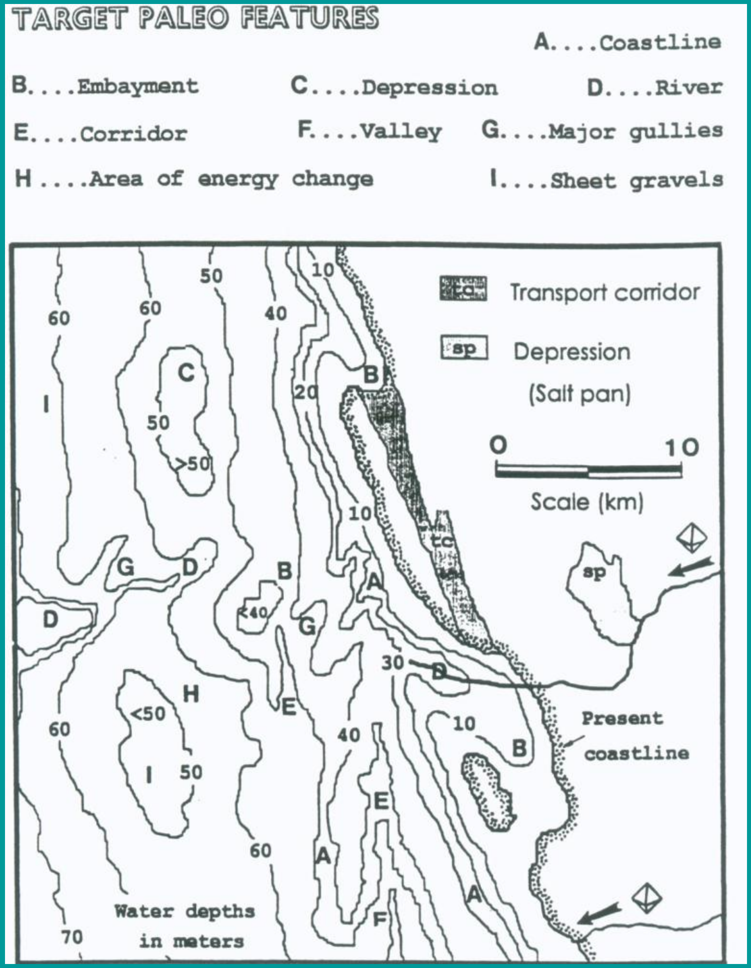
Inner & Middle Shelves of Nambia & South Africa: Diamond Sizes (Carots)



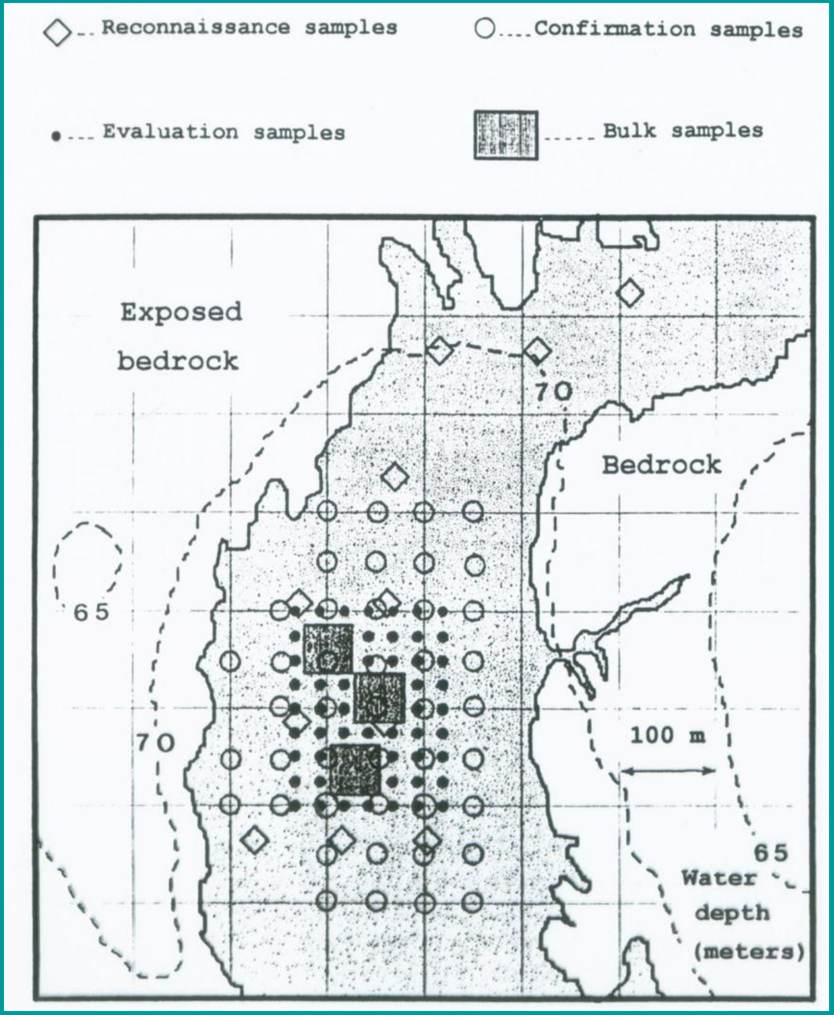
Along the coastline



Target Paleo-Features



Typical diamond accumulation features on inner shelf.



Progressive sampling of a "diamondiferous" feature.

DeBeers' High-Tech Seabed Mining Machines Now in Use

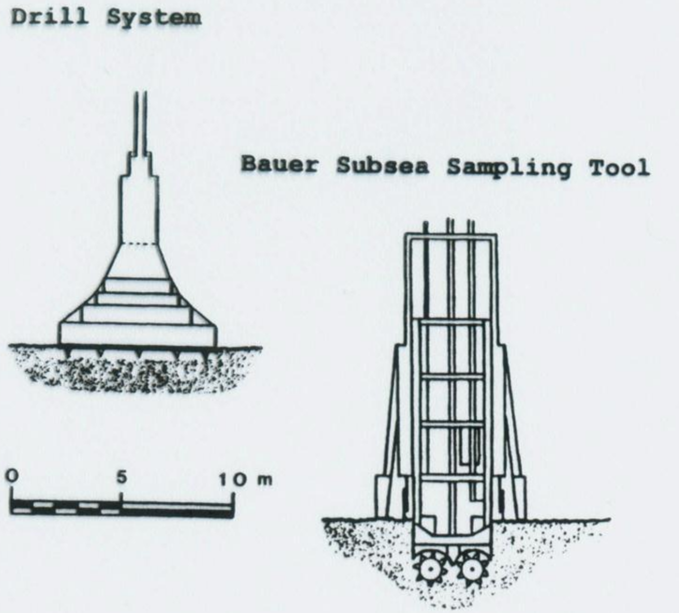
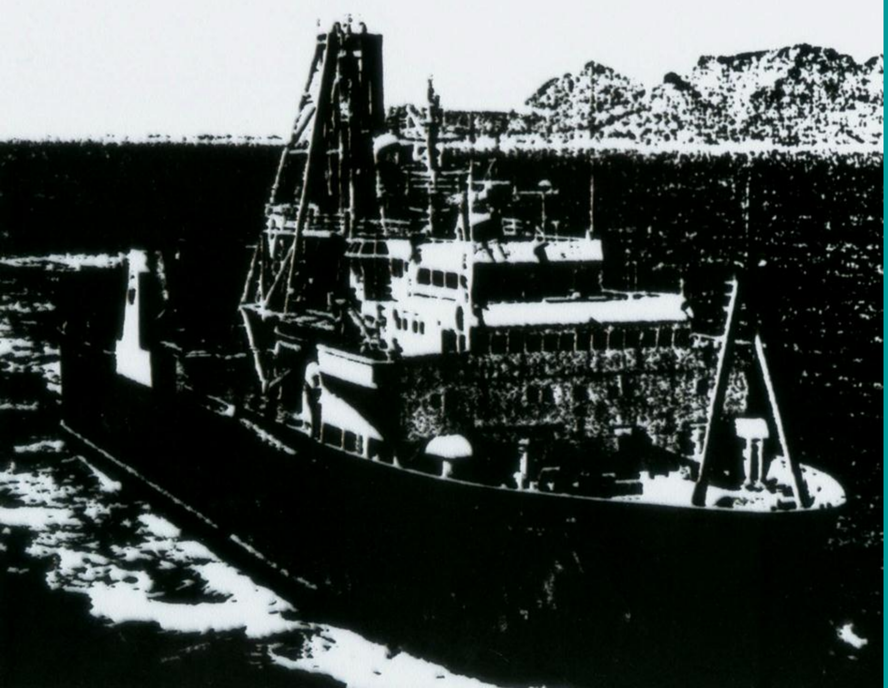
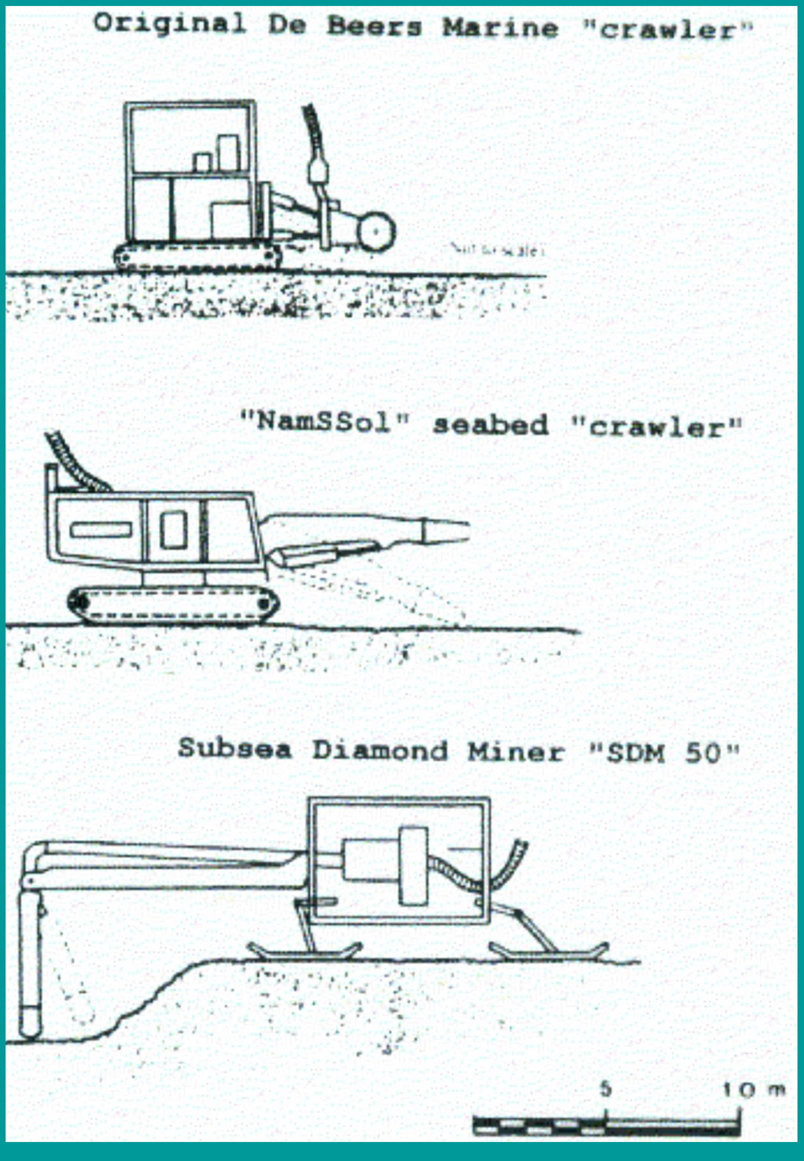


FIGURE 5.9 Large drilling systems modified for marine use.





It’s Where You Find It.