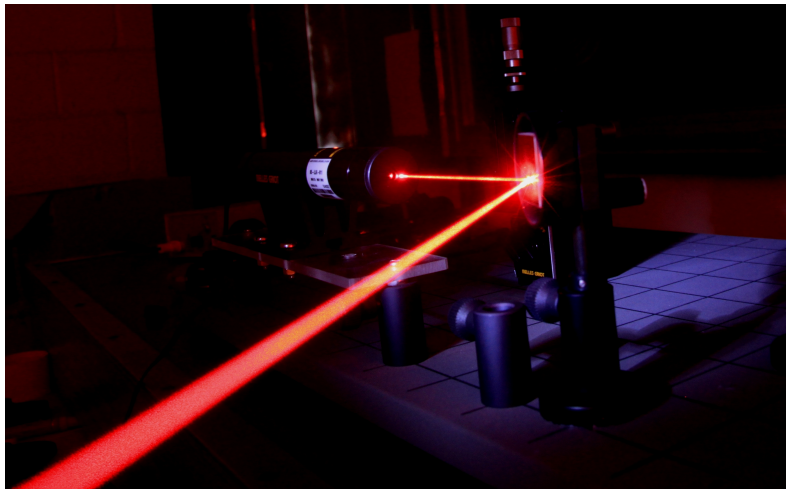
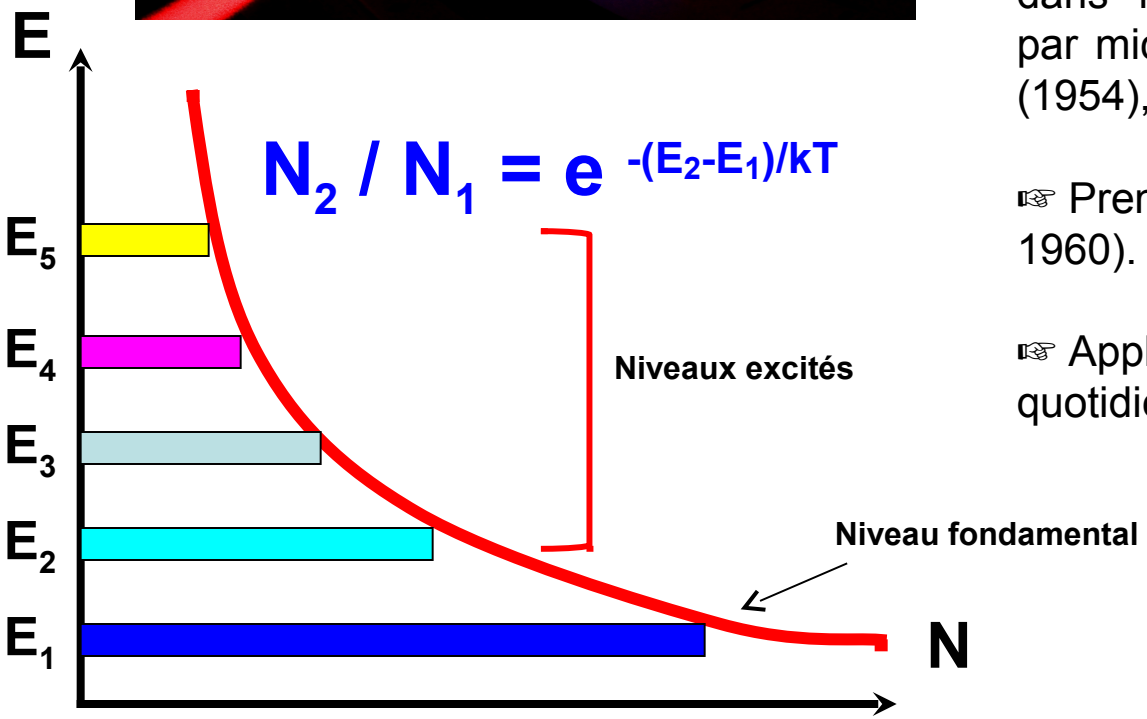
LASER: **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation





☞ Tous les systèmes permettant une amplification cohérente de la lumière par émission stimulée

☞ Principe physique de l'émission stimulée énoncé en 1917 par A. Einstein,

☞ Inversion des populations d'atomes dans les niveaux énergétiques réalisée par micro-ondes **(MASER)** par C. Townes (1954),

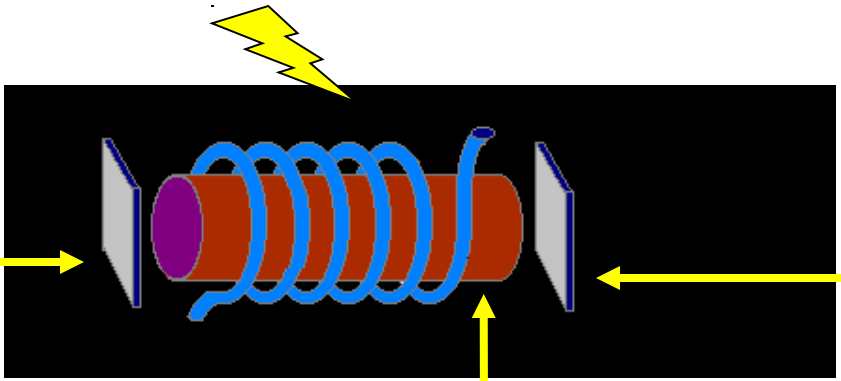
☞ Premier **laser** à rubis (T. Maiman, 1960).

☞ Applications: médical, industriel, quotidien…

LASER

Le schéma d'un laser est toujours le même, quelque soit le milieu actif, la longueur d'onde ou la durée d'impulsion

Energie de pompage



☞ Laser:

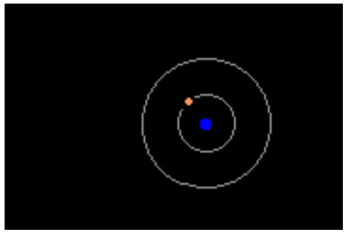
- Amplificateur (gaz ou solide)
- Résonateur optique

➪ Onde monochromatique,

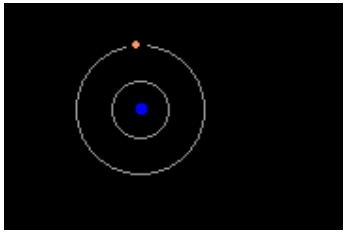
➪ Cohérente,

➪ Monodirectionelle;

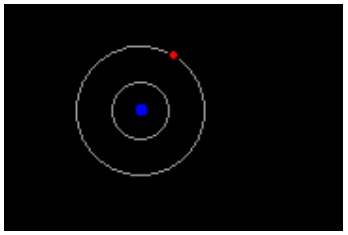
➪ *Presque* parallèle;



Absorption



Emission spontanée



Emission stimulée

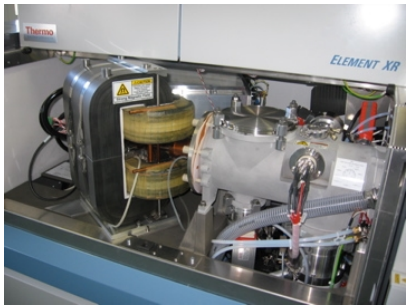
Couplage Laser / ICP-MS

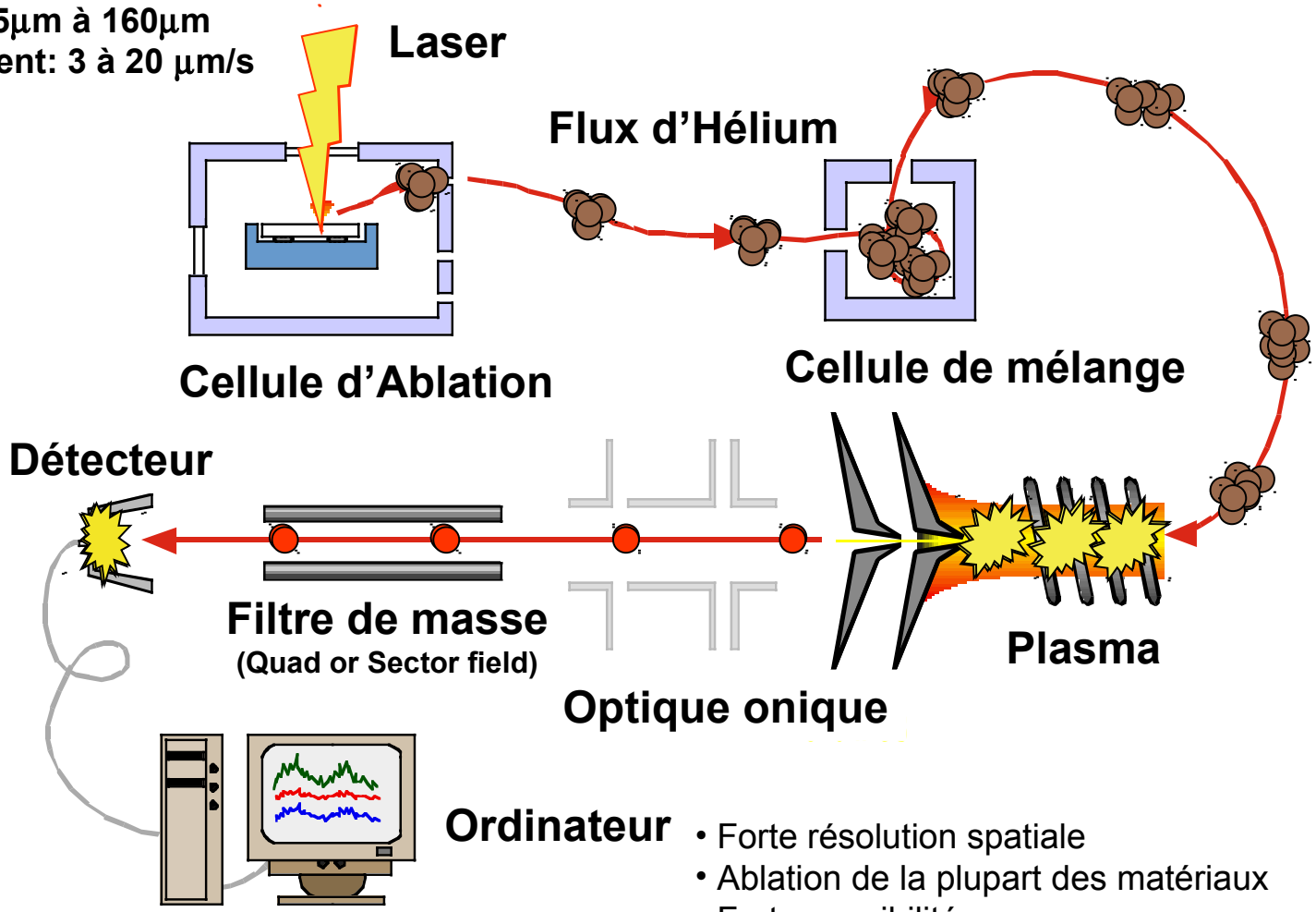
Laser Compex 102

- Laser à gaz (ArF), pulsé (25ns)
- Energie: 200 mJ
- Fréquence de tir: 1 à 20 Hz
- Diamètre d'analyse: 5µm à 160µm
- Vitesse de déplacement: 3 à 20 µm/s

Element XR

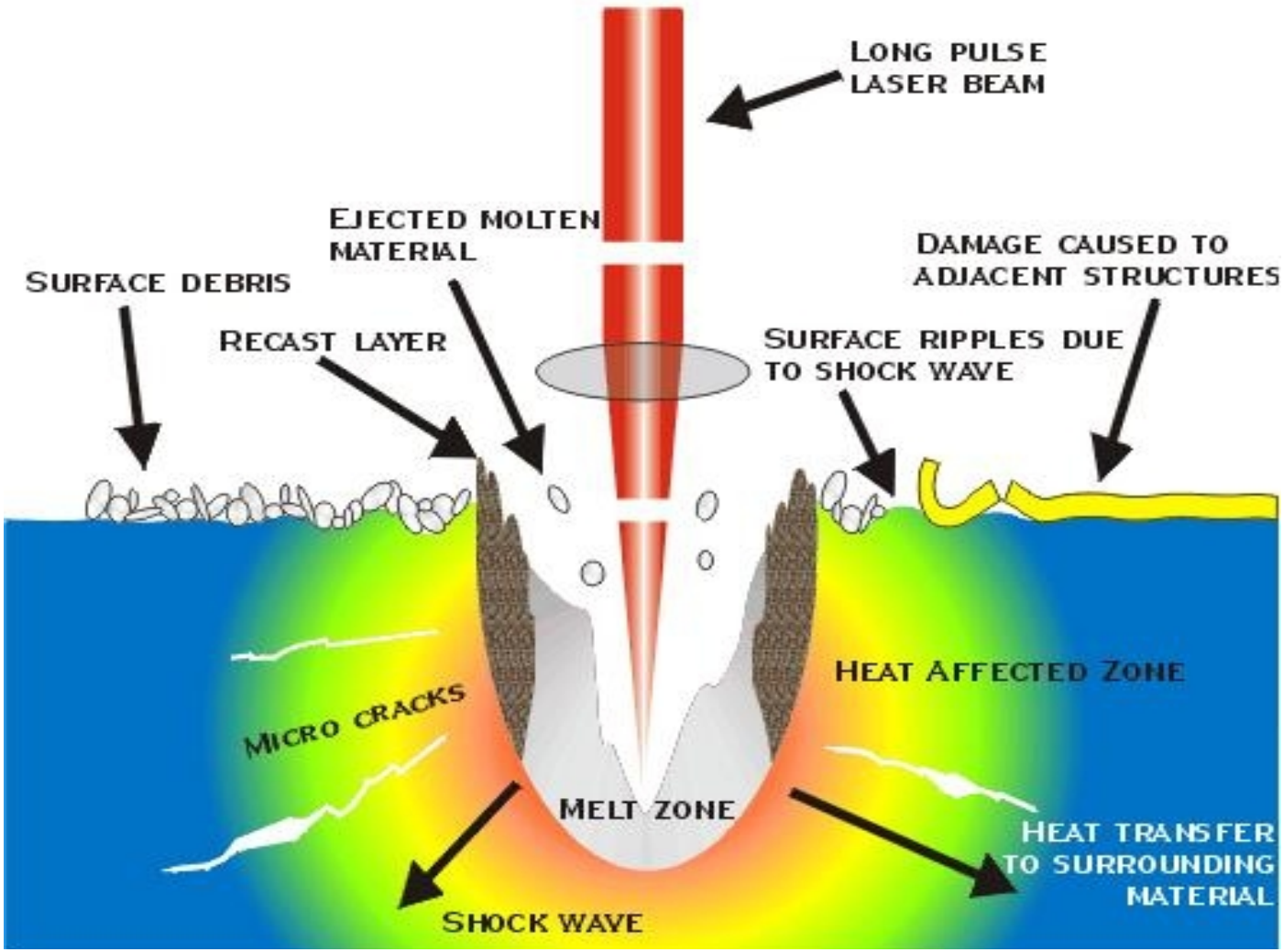
- Monocollecteur
- Secteur Magnétique
- Li à U : 150 ms





- Forte résolution spatiale
- Ablation de la plupart des matériaux
- Forte sensibilité

Energie des photons ➡ matériel cible



Effets thermiques (fusion, vaporisation, production d'atome et d'ions, plasma)

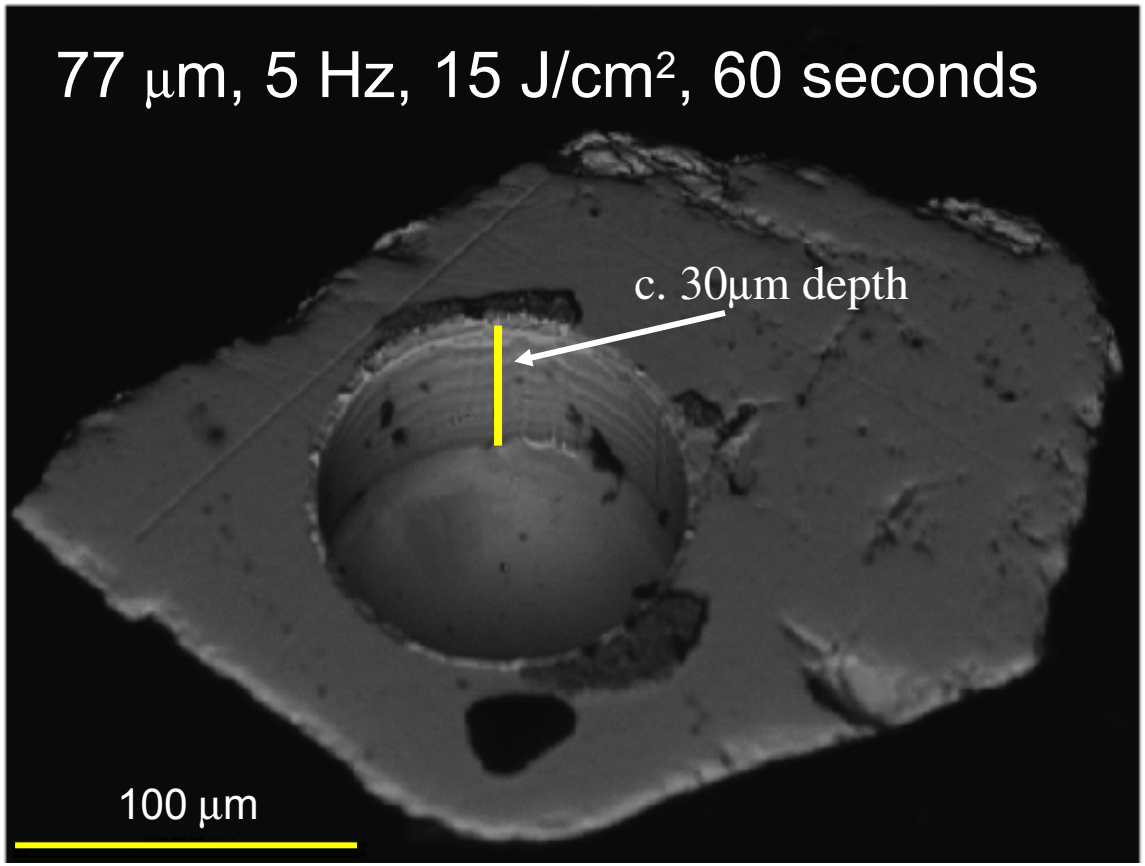
ET

Mecaniques (microfracturation, éjection de fragments)

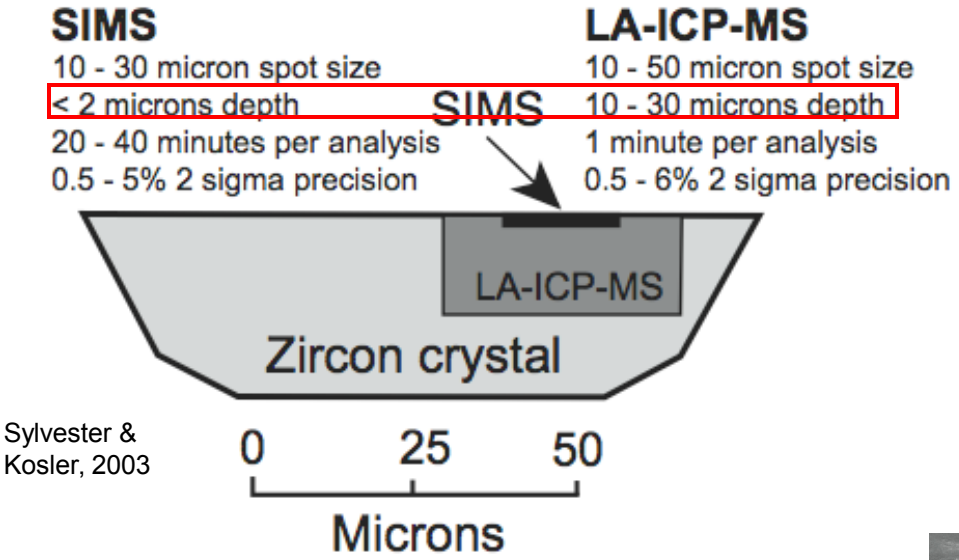
Excimer Laser (193 nm)

☞ **couplage efficace entre matériel cible et onde laser,**

☞ **Reduction des effets thermique et de l'accumulation des éjectats autour du cratère.**



Comparaison Sonde Ionique / Ablation Laser

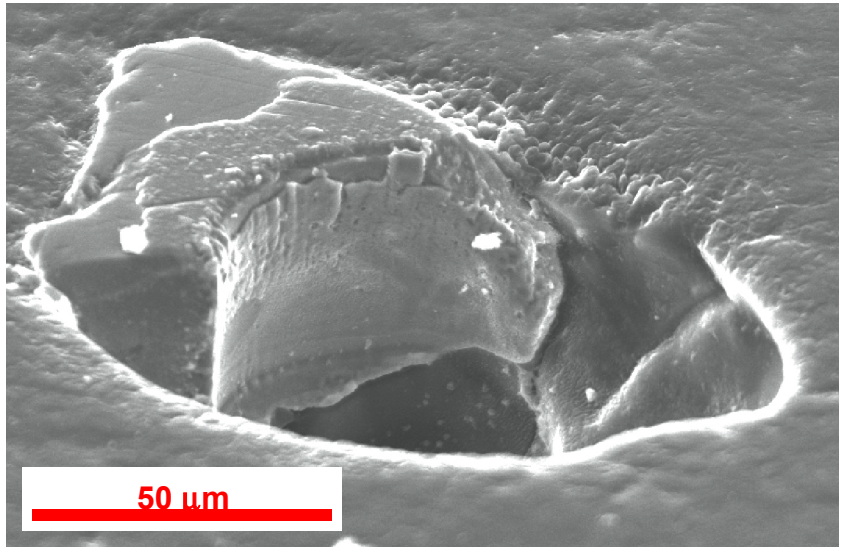


Sylvester & Kosler, 2003

Applications

Carbonates: spéléothèmes, foraminifères, otolithes…
Silicates: minéraux majeurs et accessoires…
Phosphates: coprolithes, pellets…
Verres, Céramiques, Alliages, Métaux…

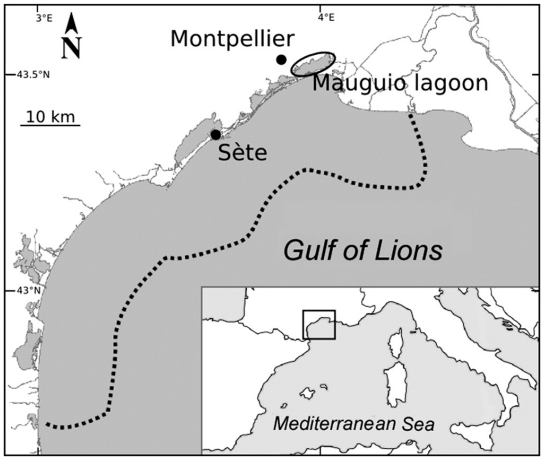
Processus destructif



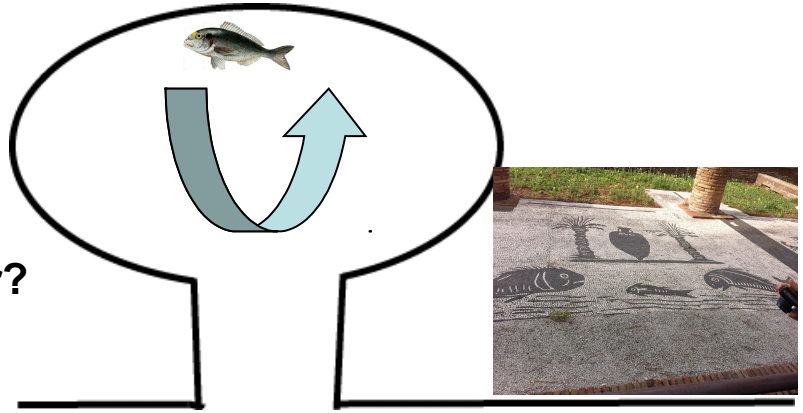
ICP-MS

Applications

Problem



High predation on mussels:
Until 3000 T/y
Gilthead Sea bream?

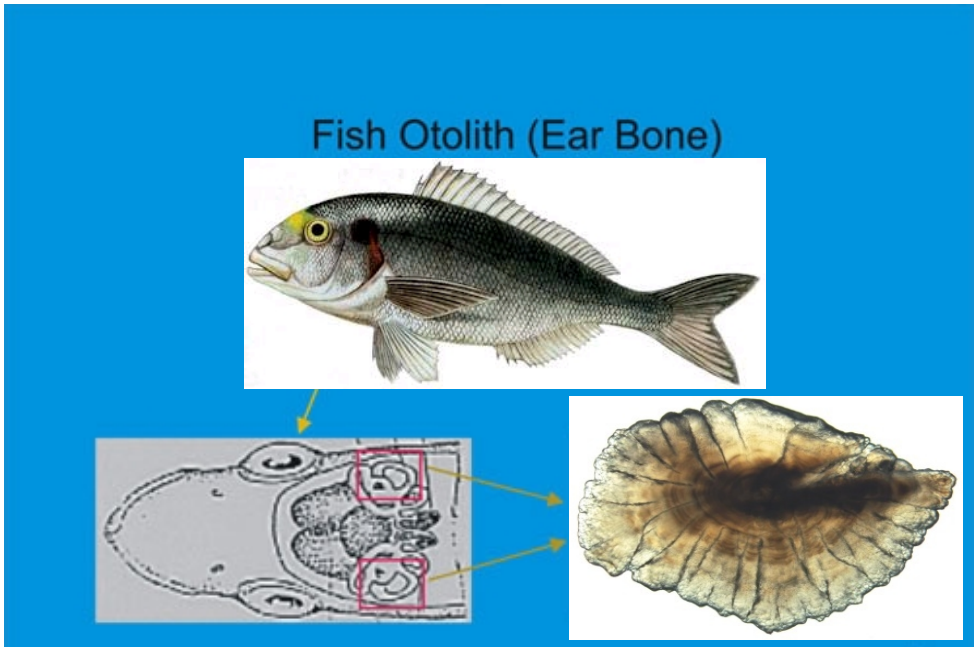


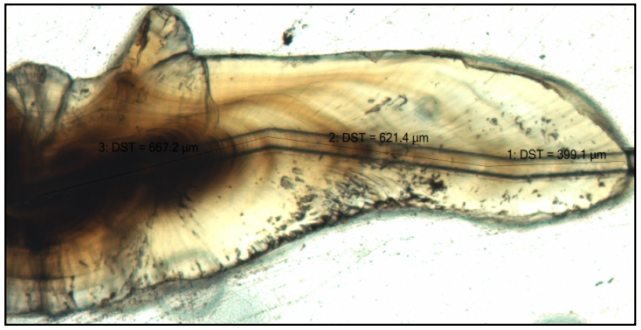
Large individuals (>1Kg)
caught in automn-winter in Thau lagoon:
What is the Gilthead Sea bream migration behaviour?

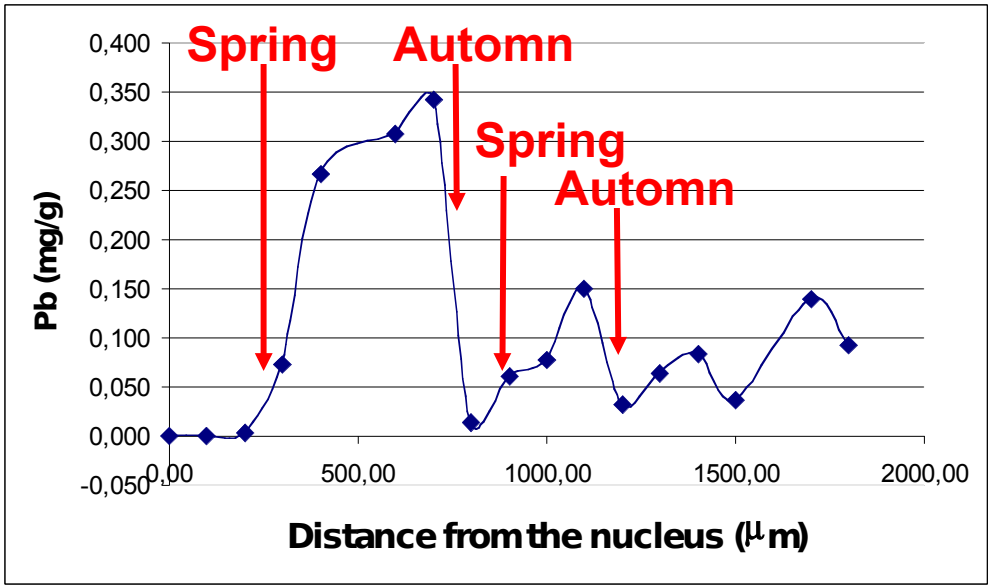
Mouillot D., et al., 2006, Ecosym

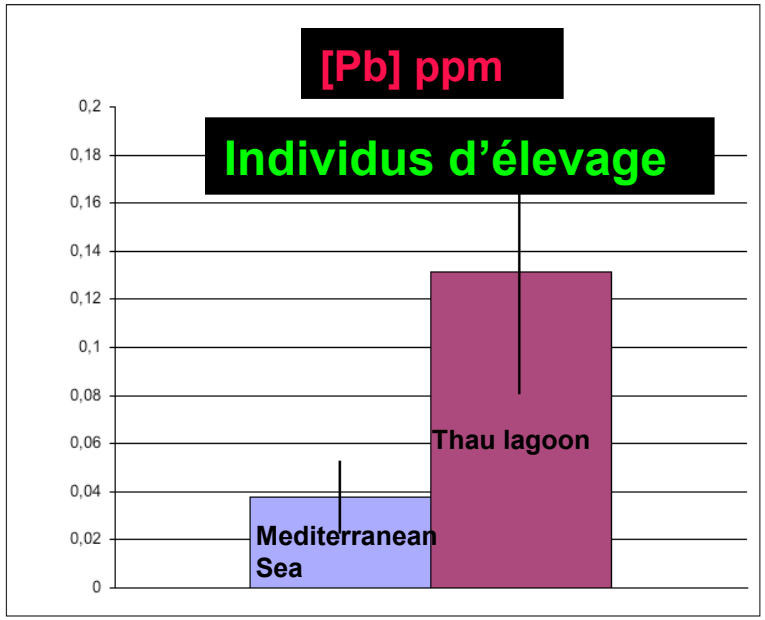
ICP-MS

Applications





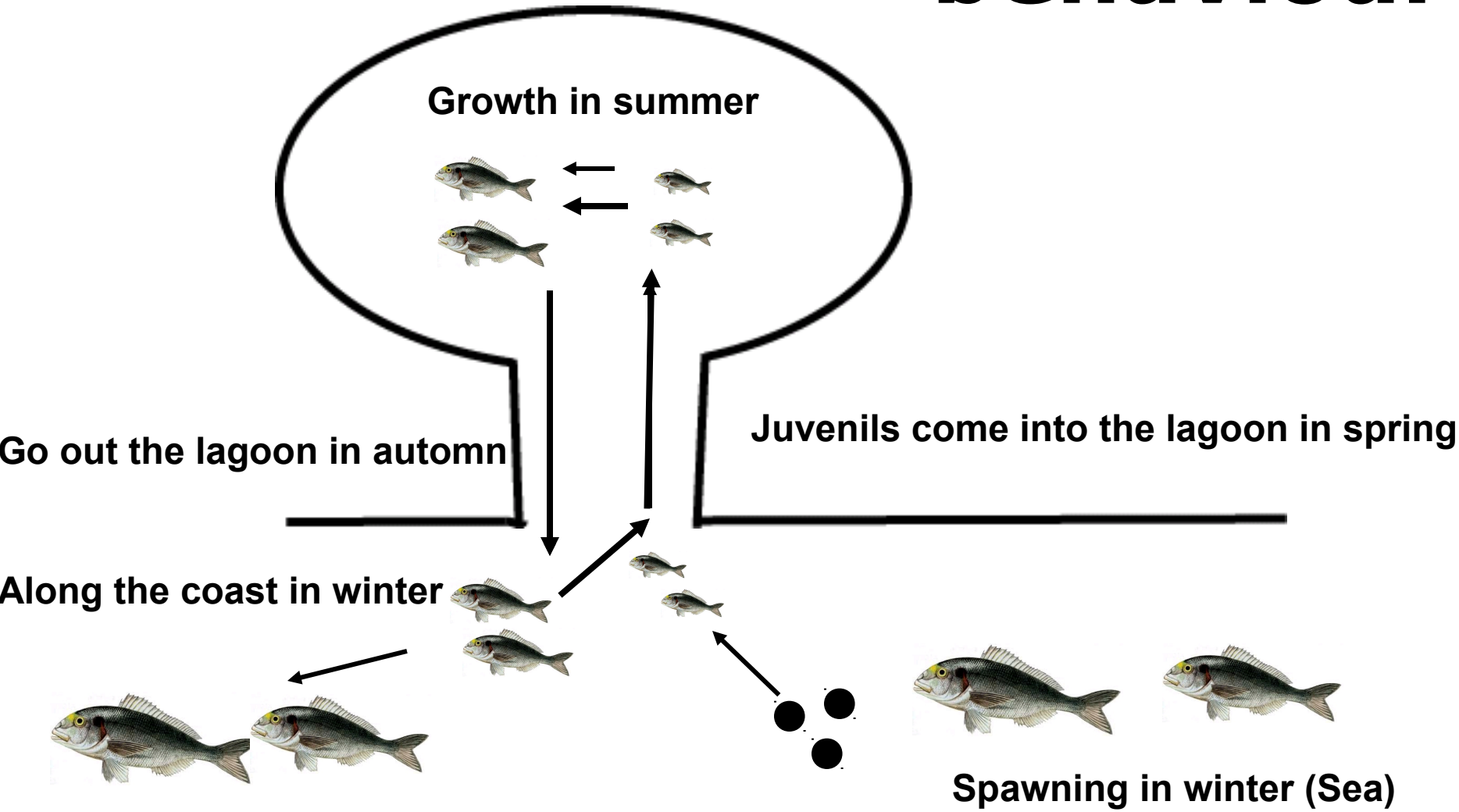




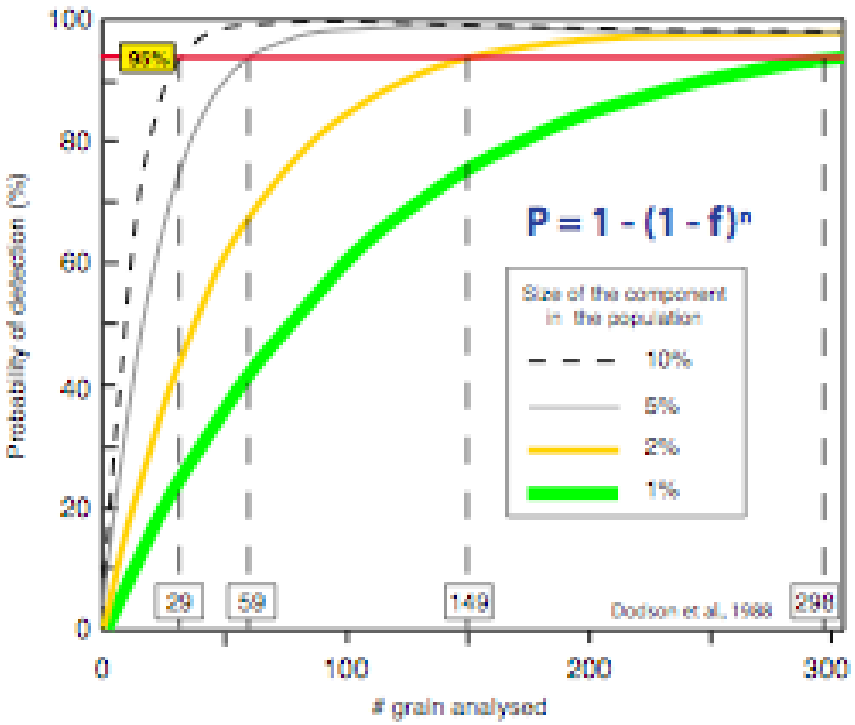
ICP-MS

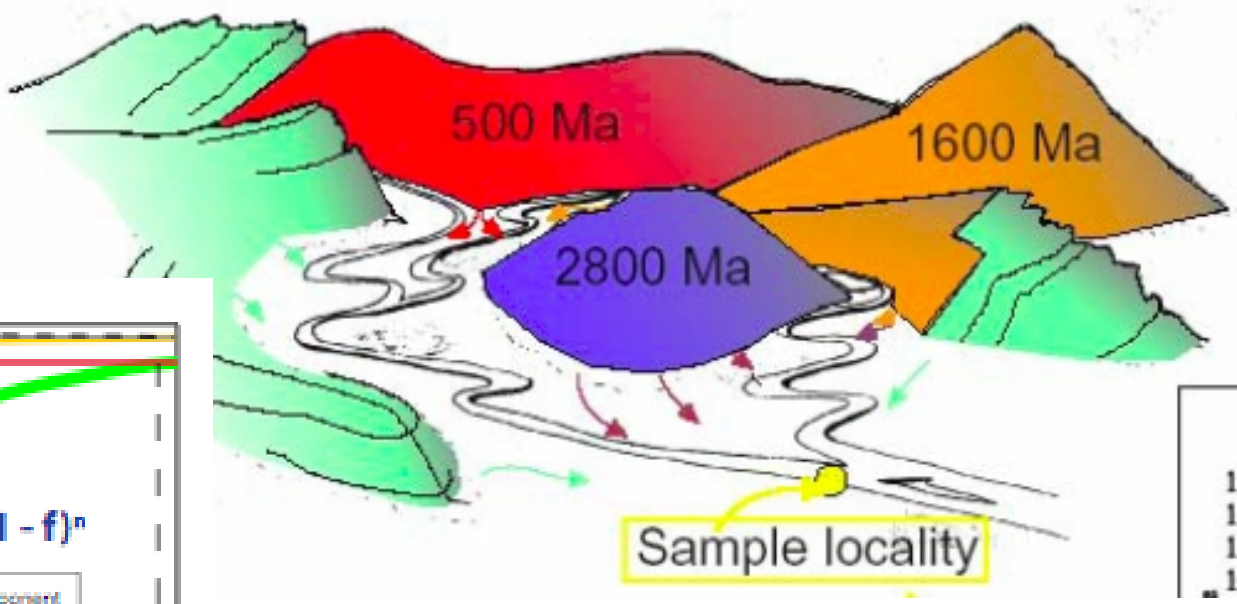
Applications

Supposed behaviour

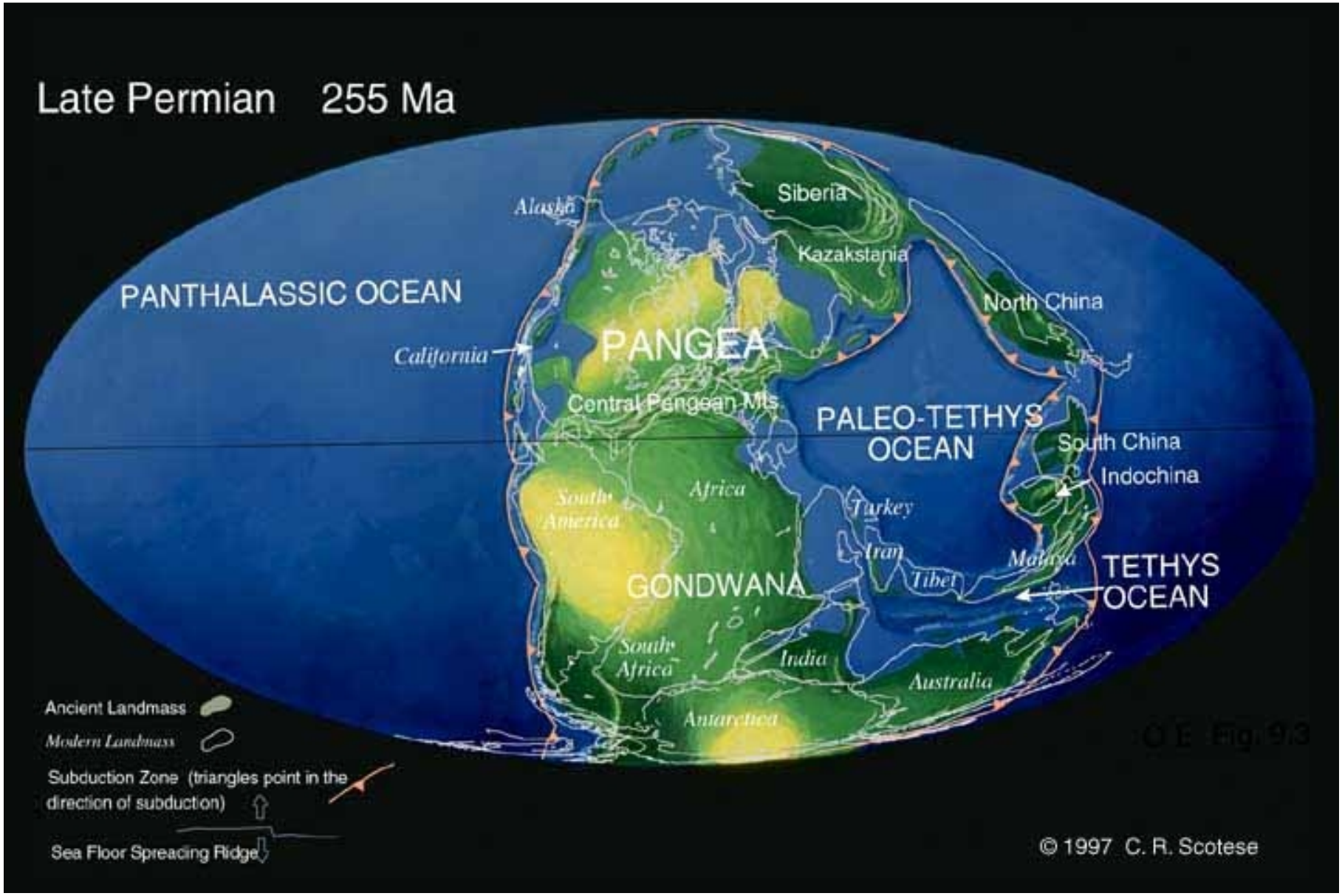


Détermination de la source des sédiments et relations entre séquences sédimentaires: les minéraux détritiques

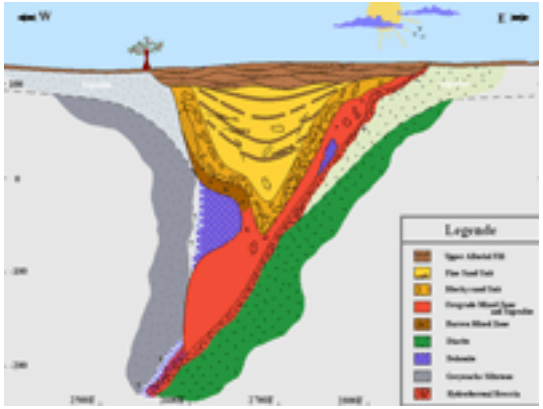


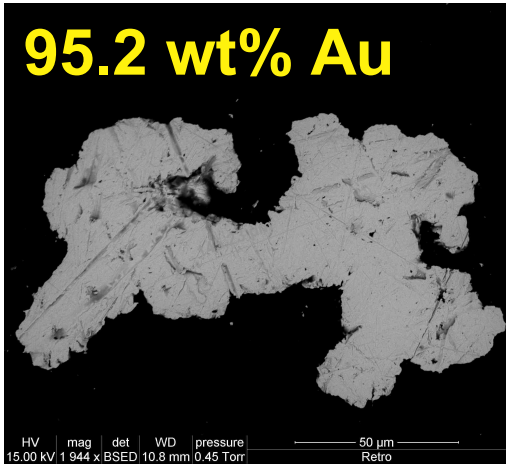


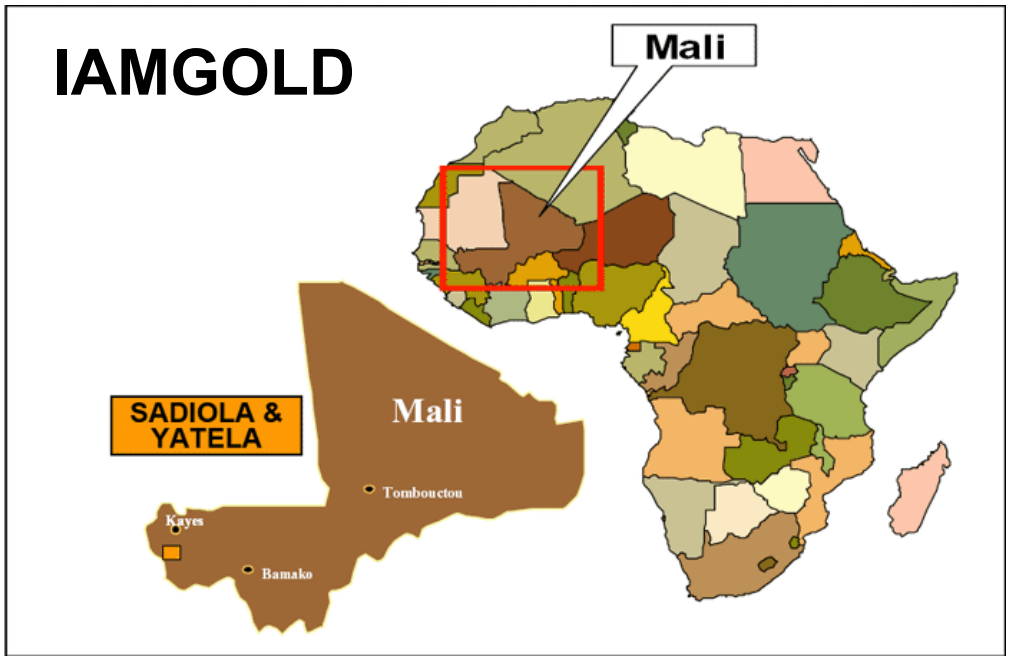
☞ **Grand nombre d'analyses pour rendre compte de la diversité des roches sources**


Late Permian 255 Ma
Siberia
Alaska
Kazakstania
PANTHALASSIC OCEAN
North China
California
PANGEA
Central Pangean Mts
PALEO-TETHYS OCEAN
South China
Indochina
Africa
South America
Turkey
Iran
Tibet
Malaya
TETHYS OCEAN
GONDWANA
South Africa
India
Australia
Antarctica
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge
© 1997 C. R. Scotese

Yatela Gold Mine (Mali)



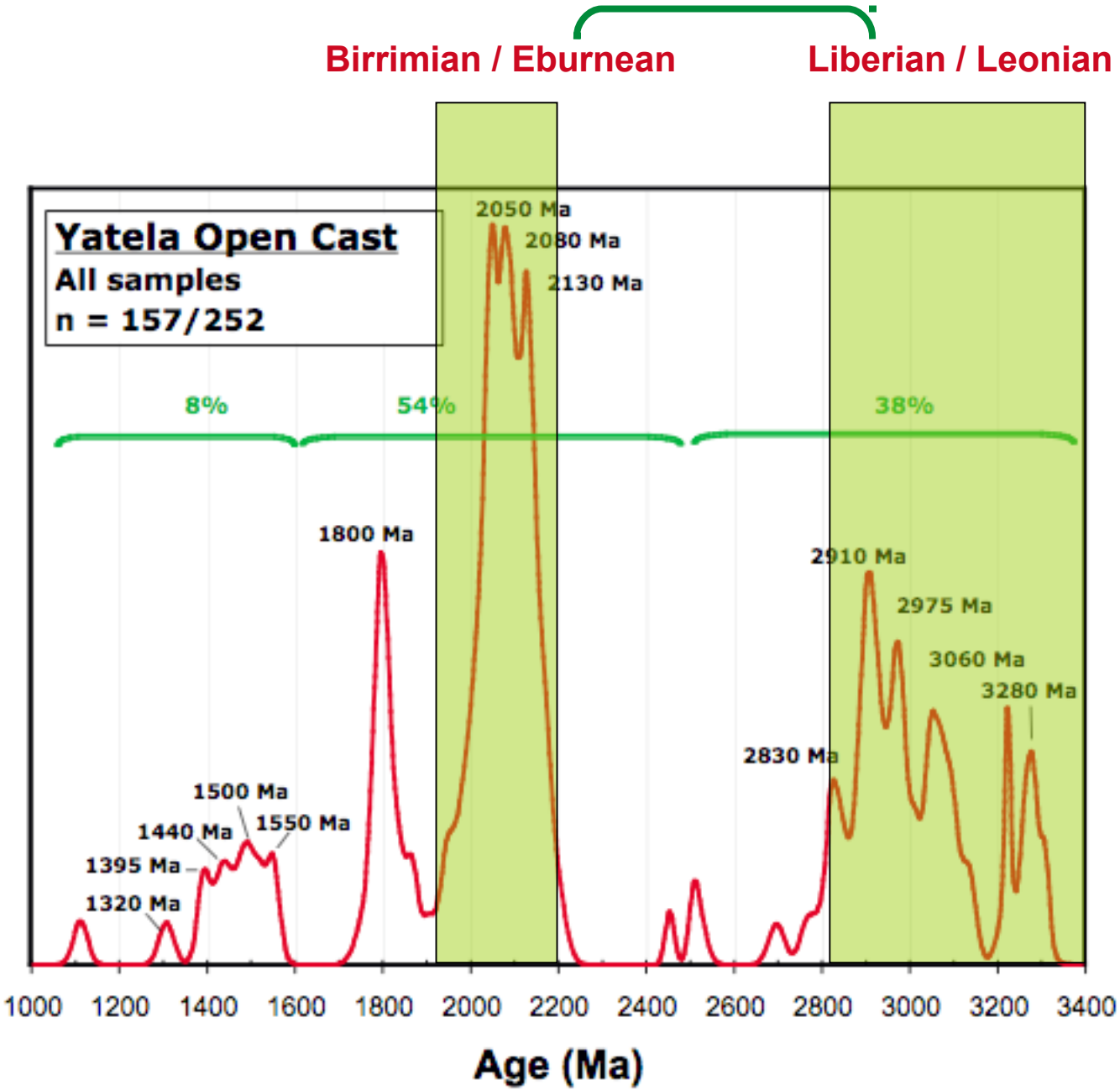


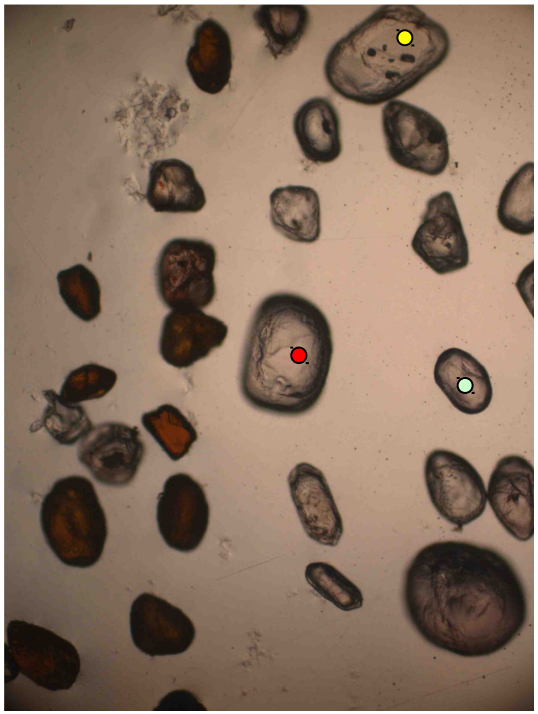


29000 oz (2012)
1200 € / oz

KENEMA-MAN DOMAIN

Provenance?





Exotic terranes of Laurentian affinity

Phanerozoic orogenic belts

Phanerozoic cover

Major and relevant Neoproterozoic to Palaeozoic basins of Africa

Late Neoproterozoic belts (Pan-African and related orogens)

pre-Neoproterozoic crust overprinted by Neoproterozoic orogenic events

Late Mesoproterozoic to Early Neoproterozoic crust (0.9-1.0 Ga) (exposed/inferred)

Mesoproterozoic crust (1.0-1.6 Ga)

Late Palaeoproterozoic to Early Mesoproterozoic crust (1.8-1.55 Ga)

Meso- to Palaeoproterozoic (not sudivided)

Archean and Palaeoproterozoic reworked during Palaeoproterozoic orogenies (1.8-2.2 Ga)

Old cratonic crust (> 2.3 Ga, Archaean to Palaeoproterozoic)

Questions ??