

# *Mineral ingredients.* A better structural control for sustainable cosmetics formulation

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*Mineral ingredients Xavier Bourrat et al.*

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What is the first advertising of  
cosmetic products of all time?

**red ocher to hold male away**



The first cosmetic rituals were related to hiding of fertility signs



- \*Camilla Power *et al.*, *Cosmetics, identity and consciousness*, 2010
- [www.radicalanthropologygroup.org](http://www.radicalanthropologygroup.org)
- \*\* Photo E. Daynès/Reconstruction Atelier Daynès, Paris. Neanderthal Chapelle-aux-Saints. 50,000 years B.P. Made on the basis of a cast of a skull discovered in La Chapelle-aux-Saints, France, from a postcranium reconstructed by Gary Sawyer, an anthropologist at AMNH.

# Minerals for cosmetics, eternal value: *3 reasons for controlling structure*



## 1. More and more minerals

1. Mineral is trendy, clean, sustainable...

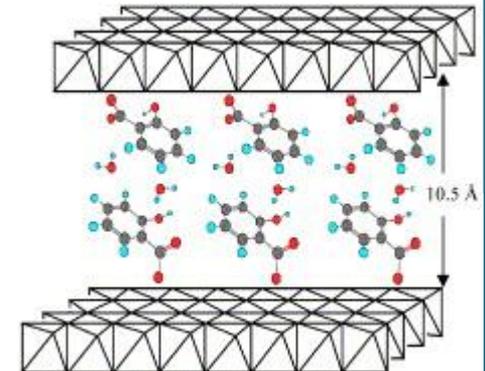
## 2. Mineral has found a 'new frontier'

1. Nano-size means 'new properties'
2. controlling optical, magnetic, surface, etc...



## 3. Customize multiscale textures with mineral ingredients

1. Hybrides : organo-mineral compounds
2. Emergence of smart fillers



# BRGM, advance in mineral science

## *agenda*

### **1. Physical properties of nanoparticles**

### **2. New analytical electron microscopes : MEB-RAMAN**

1. Example 1: assessment of the composition of an eyeshadow
2. Example 2: acetylene black, Raman characterization

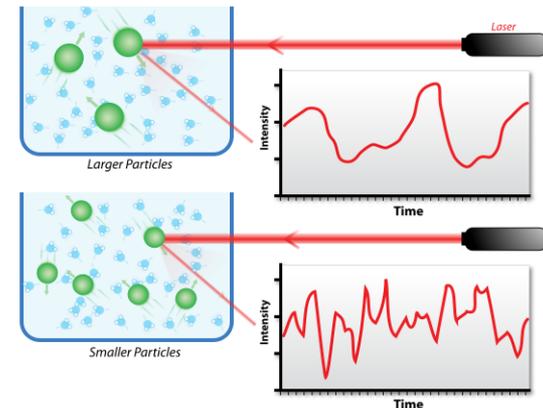
### **3. Conclusions**

# 1. Physical properties of nanoparticles

> **Aggregation, flocculation control:  
diffusion**

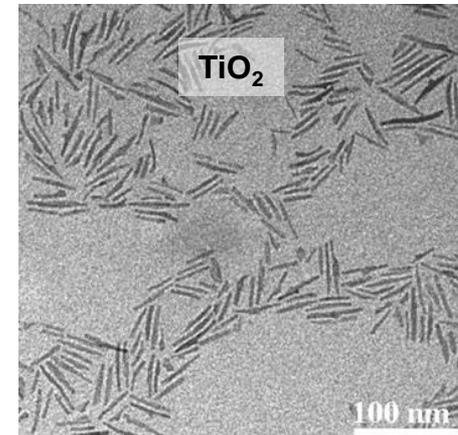
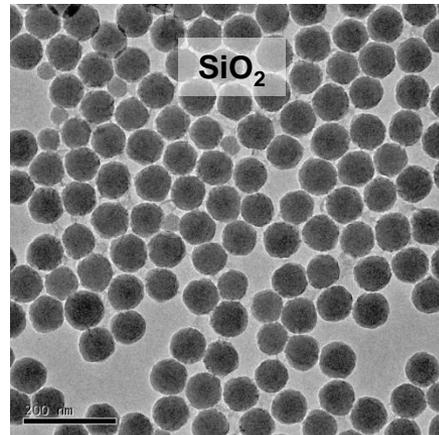
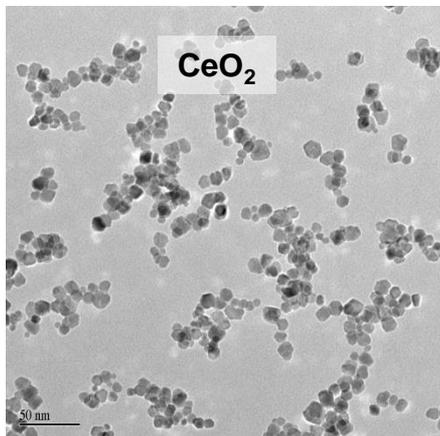
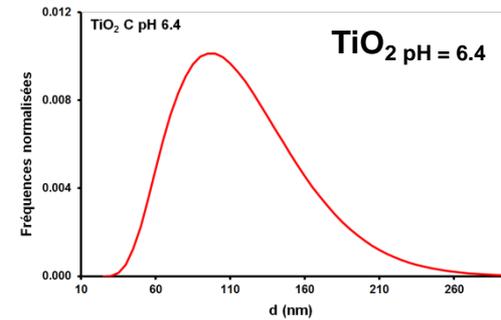
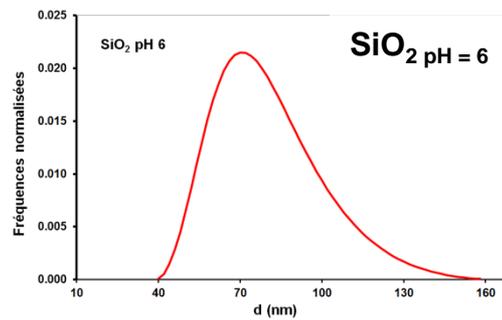
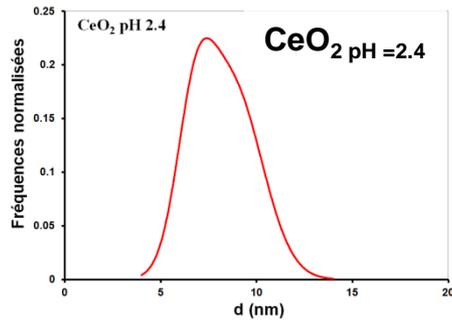
> **Particles size:**

- Diffraction/scattering,
- UV- visible
- DLS: dynamic light scattering



# Dynamic Light Scattering (DLS) vs TEM

- > **CeO<sub>2</sub>**: ellipsoidal shape between 2 and 4nm
- > **SiO<sub>2</sub>**: spherical particles 50 to 86 nm
- > **TiO<sub>2</sub>**: nanorods 18 x 24 x 168nm



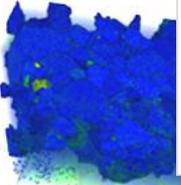
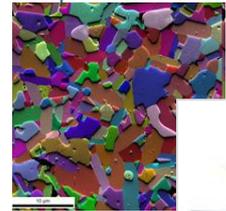
es pour une Terre durable

**uigm**

Nom du service émetteur

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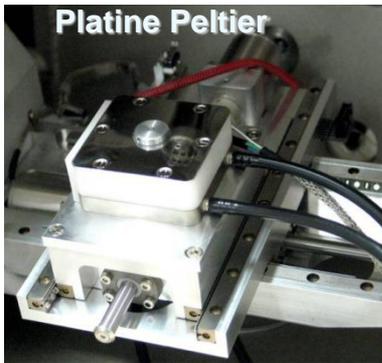
# 2. New analytical electron microscopes : MEB-RAMAN



EBSD



Platine Peltier



- Cold sample: -40/-50°C
- Wet sample without drying



SE

SE in lens

EDS / mapping

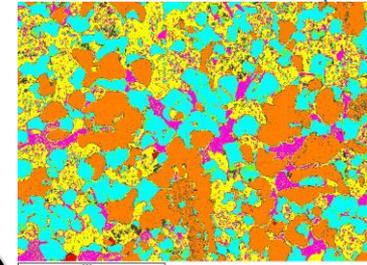
LVSTD (without coating)

BSE (YAG) / CL

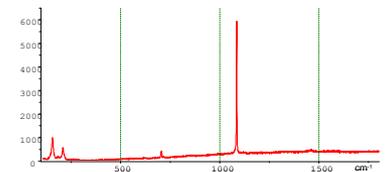
## TESCAN MIRA III XMU

TESCAN s.r.o. (Brno, Rep. Tchèque)

Resolution: 1.0 nm à 30 kV / 2.0 nm à 3 kV  
Stage: 130x130x100 mm, hmax 143 mm



## RAMAN



## 2.1 Example of the formulation of an eyeshadow

- > Sample : the popular Agnes B Monobulle eyeshadow
  - Here : metallic purple grade
- > MEB-RAMAN:
  - in low vacuum mode: sample deposited on carbon tape, as-it , no coating.



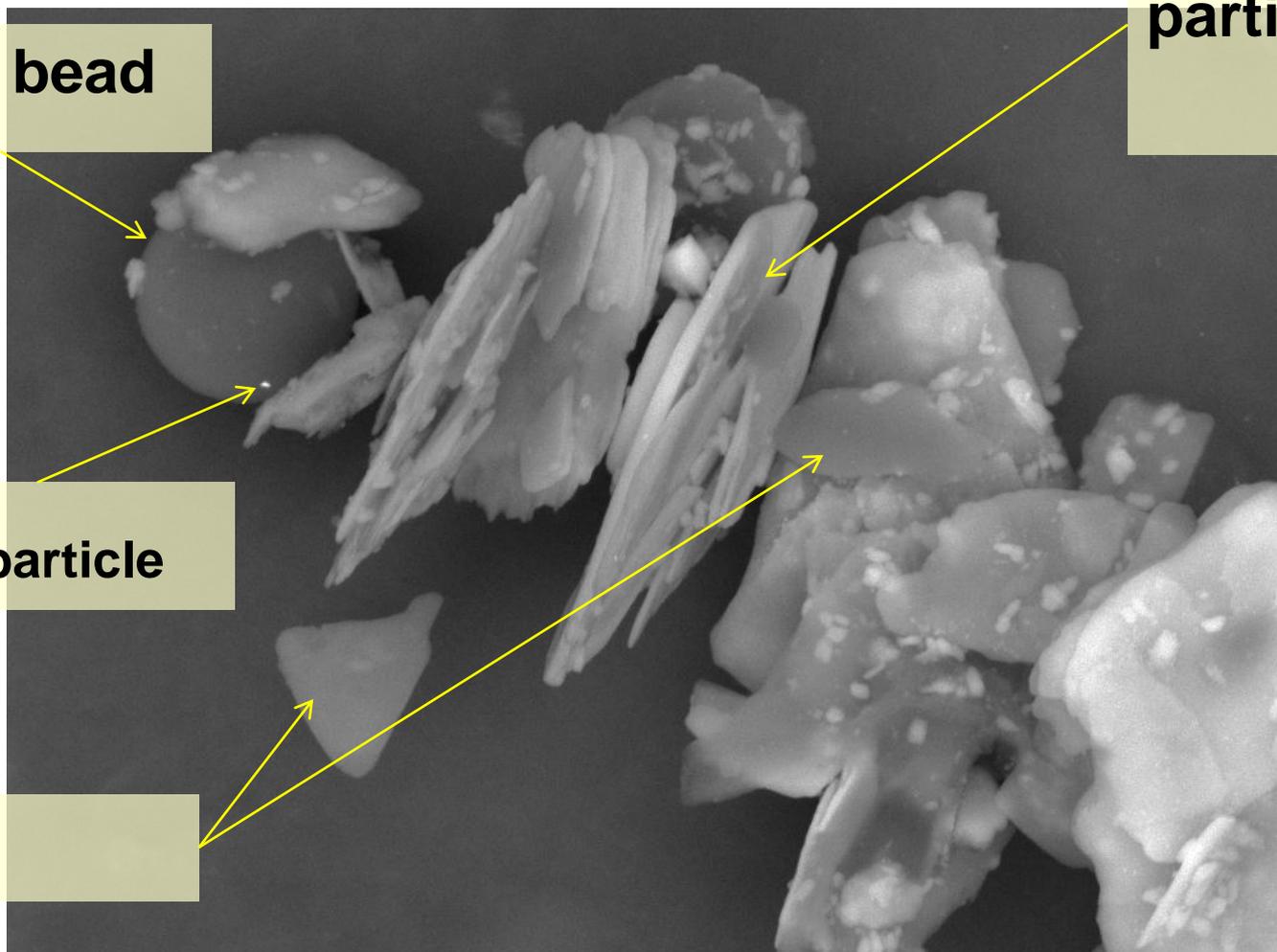
# Monobulle eyeshadow, metallic purple

Silica bead

Al lamellar particles

Bi nanoparticle

Talc



SEM HV: 25.0 kV	WD: 16.54 mm	MIRA3 TESCAN
View field: 101 $\mu$ m	Det: BSE	
SM: RESOLUTION	SEM MAG: 2.50 kx	BRGM/ISTO



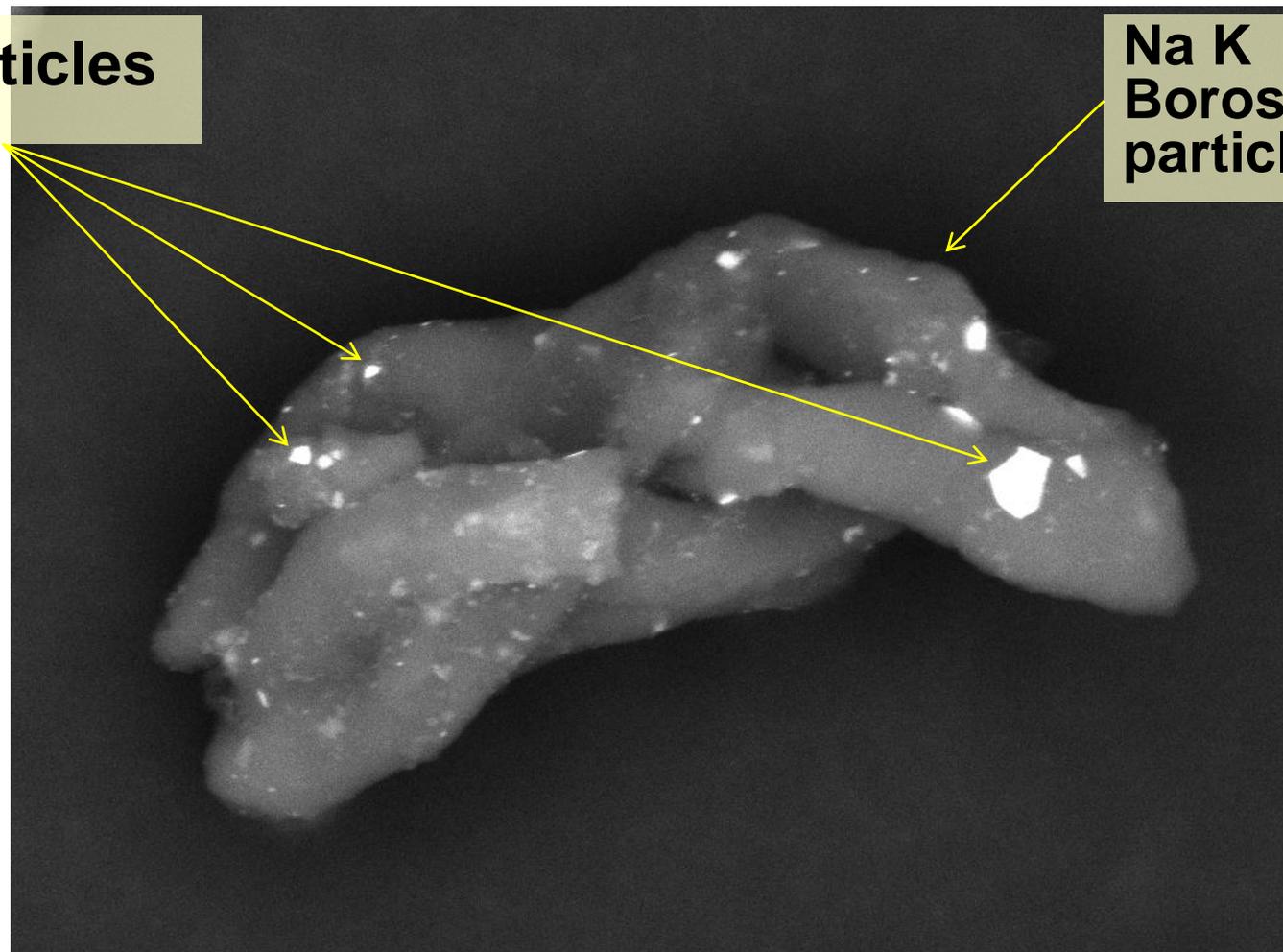
ces pour une Terre durable



# Monobulle eyeshadow, metallic purple

**Bi particles**

**Na K  
Borosilicate  
particle**



SEM HV: 25.0 kV	WD: 16.47 mm		MIRA3 TESCAN <small>ces pour une Terre durable</small>
View field: 50.6 µm	Det: BSE		10 µm
SM: RESOLUTION	SEM MAG: 5.00 kx	BRGM/ISTO	

# Monobulle, metallic purple : formulation

## > Filler

- Ca Na K borosilicate
- Talc
- Mica
- Alumina

## > Nano spheres:

- Silica
- Aluminum
- Titanum dioxyde

## > Pigments

- Alumine or Al hydroxide, in form of thin lamellar plates
- (Bronze and Copper powder)
- Mica coated with Bismuth oxychloride, Tin, Titanium, Iron, Chromium oxydes



# Example 2: Acetylene Black, how controlling a deep black color?

**Application:** mascaras, eyeliners, brush-on-brow, eye shadows, lipsticks, blushers & foundations.

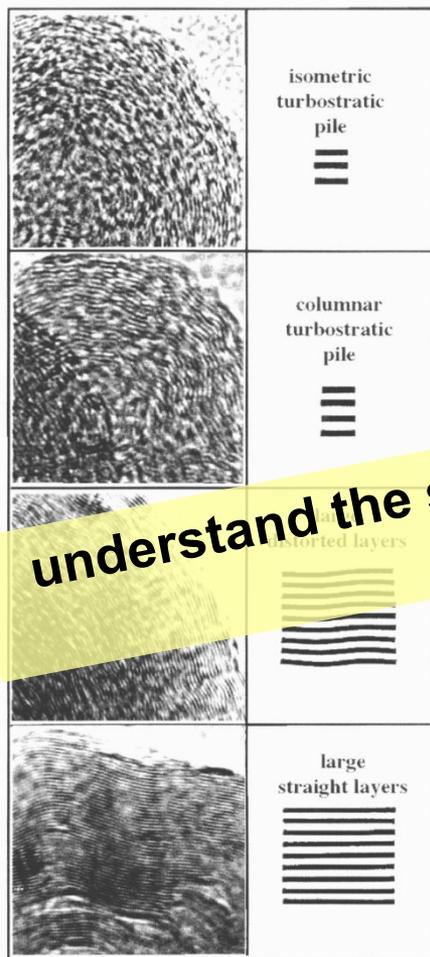
## > Comparaison of acetylene blacks

- TEM structure vs
- fractal geometry and
- Raman spectroscopy

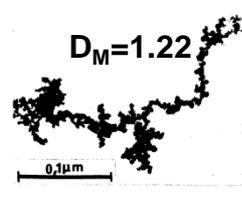
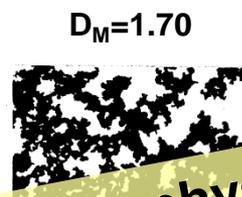
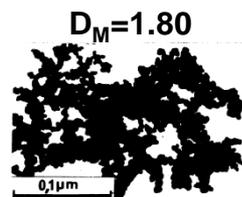


# Organic pigment: acetylene black

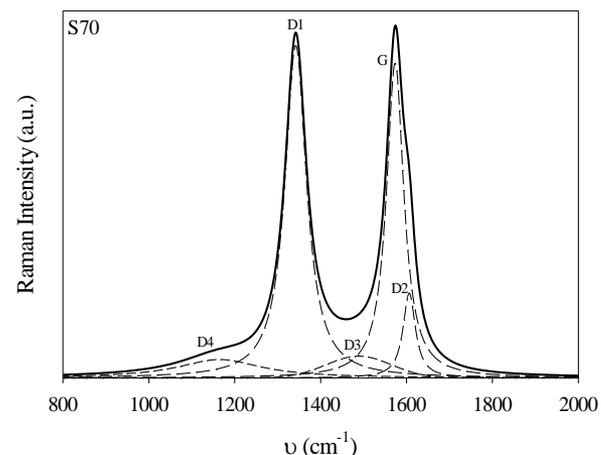
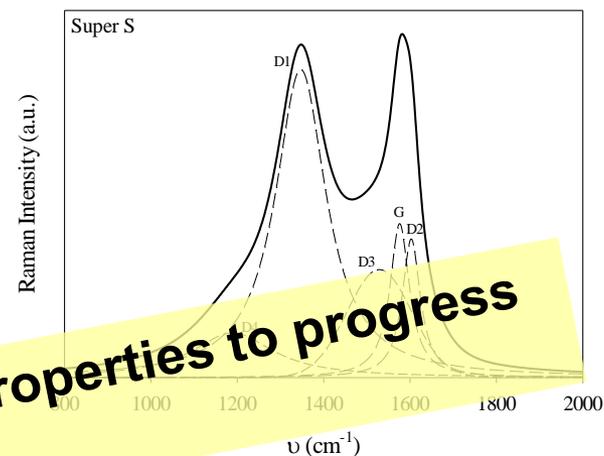
Electron microscope



Mass Fractal dimension



Raman



understand the structure, the physical properties to progress in the nanoworld



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## CONCLUSIONS

- BRGM French Geological Survey : a long expertise in physics, structure and texture of minerals
- Nanometrology
  - MEB-RAMAN
  - Physics of nanoparticles
- Processing of nano-structured materials
  - LDH or clays for micro-patch

-1.89 3740.46 -625.5



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