"It's not about describing rocks, it is about gathering information"

Descriptive Lithology: Analysis of Cuttings and Cores

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Introduction

- Systematic approach to describing drill cuttings and cores using the binocular microscope and reflected light
- Examination and identification of sedimentary rocks and minerals
- Describing reservoir and non-reservoir facies: sandstone, limestone, and dolomite
  - Texture, Structures, Diagenesis
  - Porosity estimates
  - Test methods
  - Sources of error
- Practical applications to reinforce key concepts

Why Descriptive Lithology?

- **Millions of boxes of core and cuttings**
- **Bypassed Plays**
  - ✓ **Mission Canyon**
    - **Many Mission Canyon Fields have Shell dry holes offsetting them**
    - **Shell's stratigraphic model of prograding sabhka deposits**
    - **Shell underestimated the risk: too few wells to test their stratigraphic concept**
  - ✓ **Shongaloo Field – State Line Graben, Arkansas – 159 BCFG; 19.7 MMBO**
    - **Marathon discovered the field after drilling two dry holes on the crest in 1954 and 1972**
    - **Integrated well, core and seismic data revealed that the field's true size extended beyond and included the "dry holes"**
  - ✓ **Trend Exploration – Irian Jaya**
    - **Sample cuttings analysis from Shell dry holes defined the pinnacle reef fairway**
    - **Shell's seismic data was shot around steeply-sloped hills on the coastal plain – compaction drape over the pinnacle reefs.**
  - ✓ **James Lime**
    - **Cuttings of reef detritus leads to recognition of bi-modal porosity system**
    - **Allows water-free production in rocks with 50% water saturation on logs**

Value of Cuttings & Core Description

- Perception is that the quality of data is limited
- Large data resource available
  - ✓ Back to the basics
  - ✓ Need to use all the data
- Facies mapping
  - ✓ Framework
  - ✓ Wireline log calibration
- Reservoir description
  - ✓ Nature of porosity
    - Pore types
    - Pore distribution
  - ✓ Diagenesis
- Wireline log interpretation quality assurance
  - ✓ Calibration to the rocks
    - Matrix
    - Accessory minerals
  - ✓ Improved interpretation
- It is not about describing the rocks, it is about Extracting Information!

Agenda

- Introduction and Review
  - ✓ Tools and Equipment
  - ✓ Sedimentary Minerals
  - ✓ Cavings and Foreign Material
  - ✓ Rock properties, e.g. Color, Texture, Porosity
  - ✓ Oil Staining
- Rock Types and Classification
  - ✓ Clastics
  - ✓ Limestone
  - ✓ Dolomite
  - ✓ Evaporites
  - ✓ Miscellaneous
- Final Exercise

Lithologic Description Workflow

- **Porosity**
  - ✓ **Estimating Percentage**
  - ✓ **Porosity Types**
  - ✓ **Permeability Relationship**
- **Sample Shows – Oil Staining**
- **Lithology**
- **Grain Size**
- **Rounding**
- **Sorting**
- **Framework**

Lithologic Description

- Diagenesis and Secondary Cement
- Lithologic Description
  - ✓ Lithology
    - Clastics
    - Carbonates
      - Limestone
      - Dolomite
  - ✓ Color
  - ✓ Texture
  - ✓ Accessory Minerals
  - ✓ Fossils
- Sample Preparation
- Foreign Matter and Cavings

Other Topics

- Depositional Environments
- Wireline Log Response to Lithology
- Diagenesis
  - ✓ Cementation and Kaolinization
  - ✓ Metasomatism and Dolomitization
  - ✓ Fracturing
  - ✓ Leaching
- Fossils and Rock Builders
  - ✓ Algae
  - ✓ Coral
  - ✓ Sponges

Summary

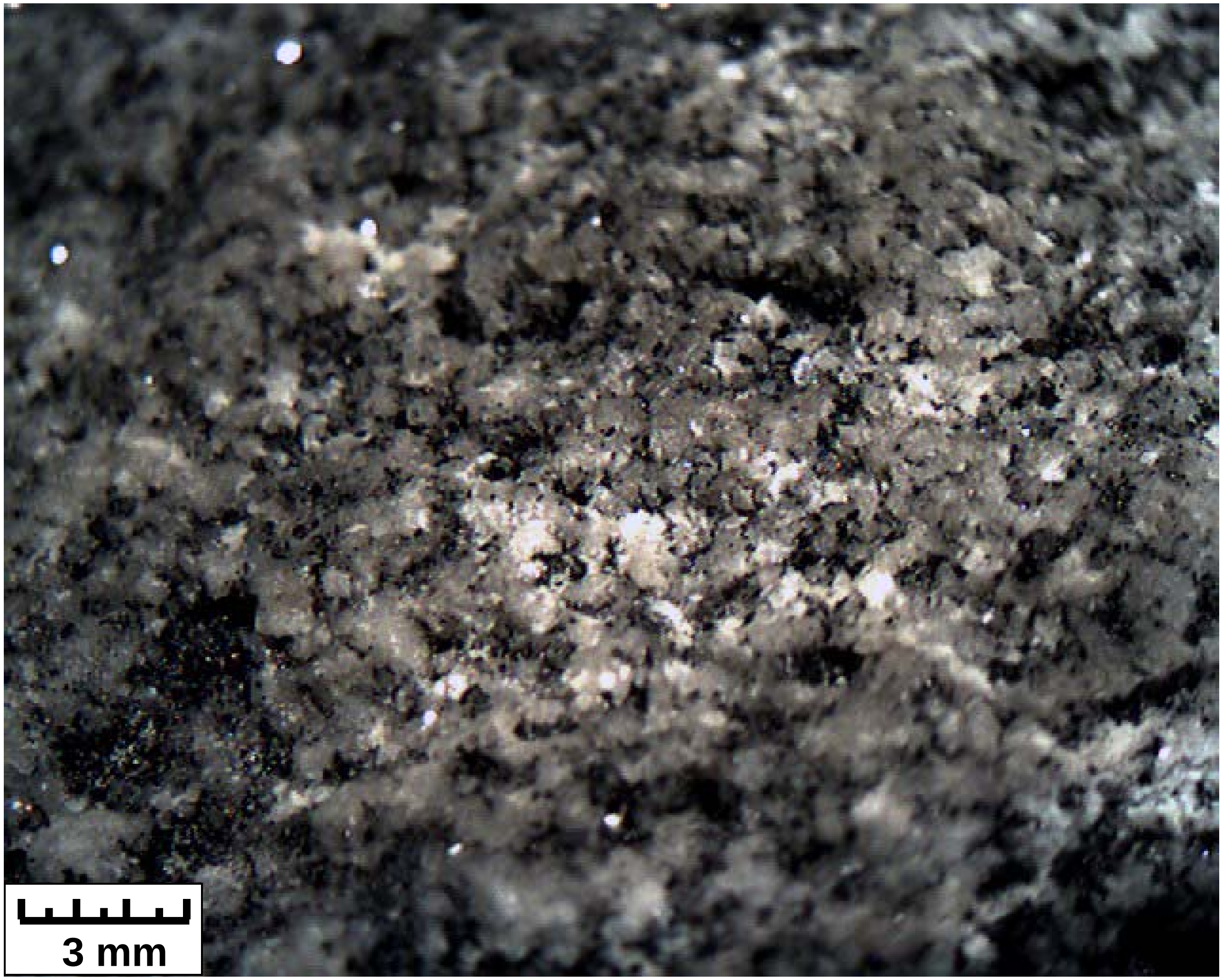
- Principals of cuttings and core examination with the binocular microscope, including sample properties and wireline log response.
- Sandstone, sandstone components, porosity and other physical characteristics.
- Siltstone and Shale
- Carbonate classification, limestone and dolomite characteristics and diagenesis
- Fossils
- Evaporites and other miscellaneous rock types
- Logging exercises

Lower Manville Sandstone

Ss lt gy-brn, abnt cht frag, sl dol, sil, kao cmt, lt cut, g flor S-1, K-1

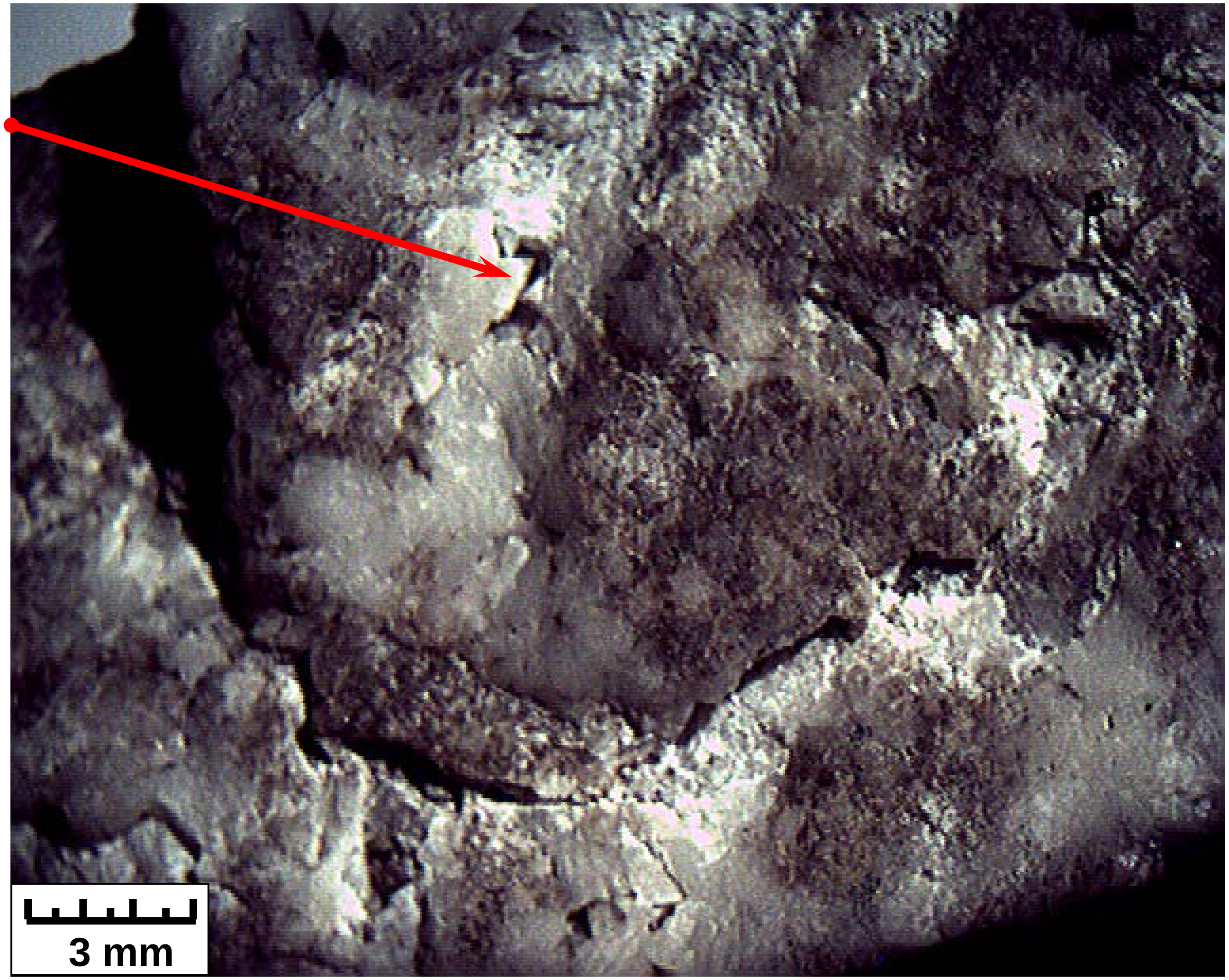
Crystalline Dolomite

Metasomatic Dolomite with Anhydrite Cement; Bitumen staining in pores

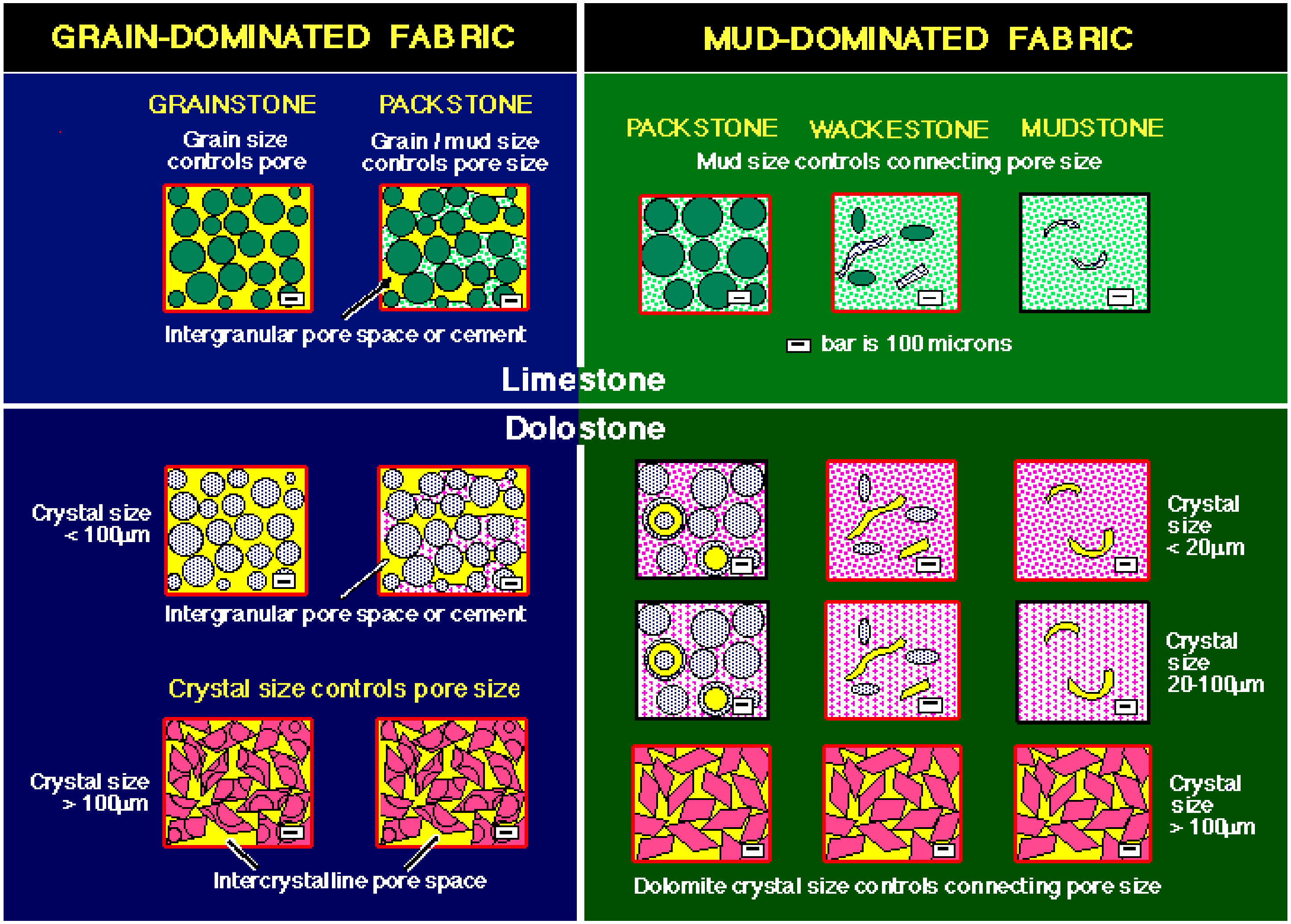


Dolomite: Leached & Cemented

White dolomite crystals



Carbonate Classification



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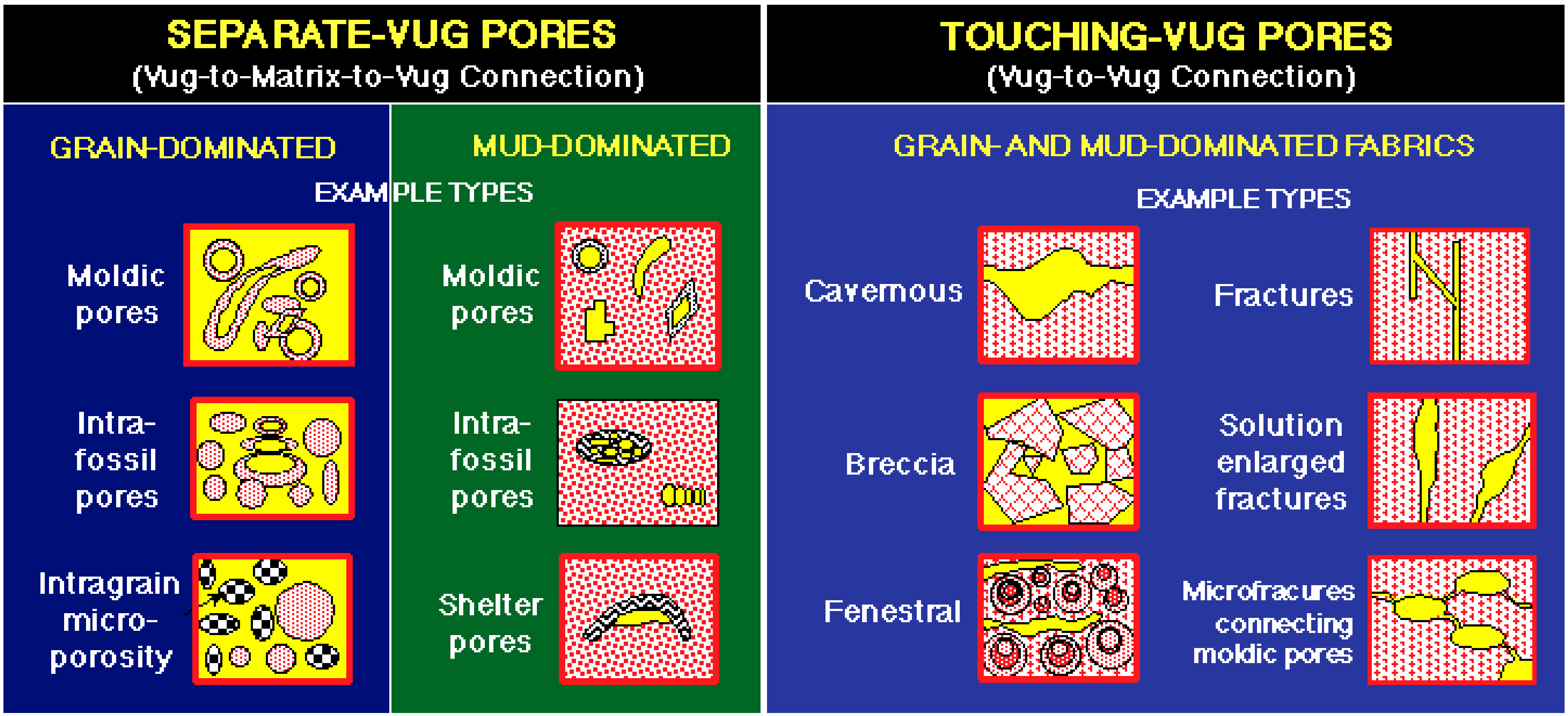
Vuggy Carbonate Porosity



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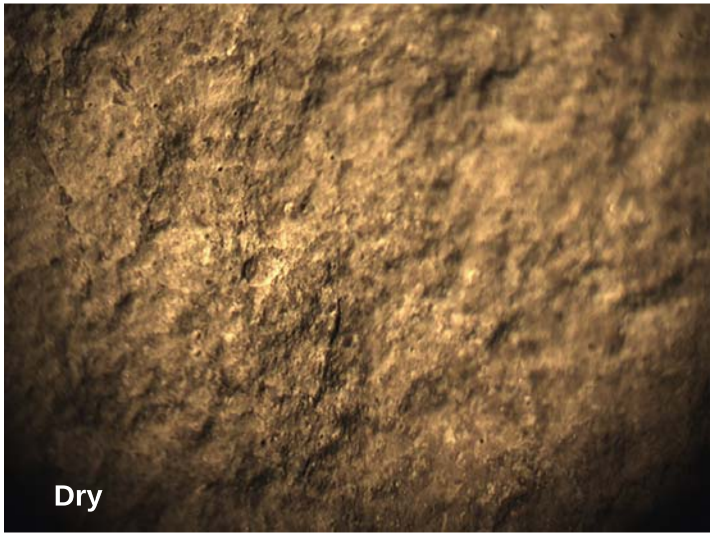
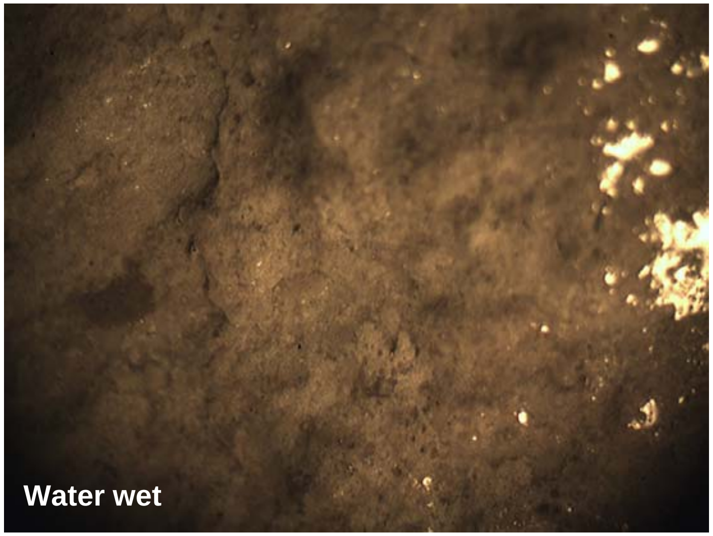
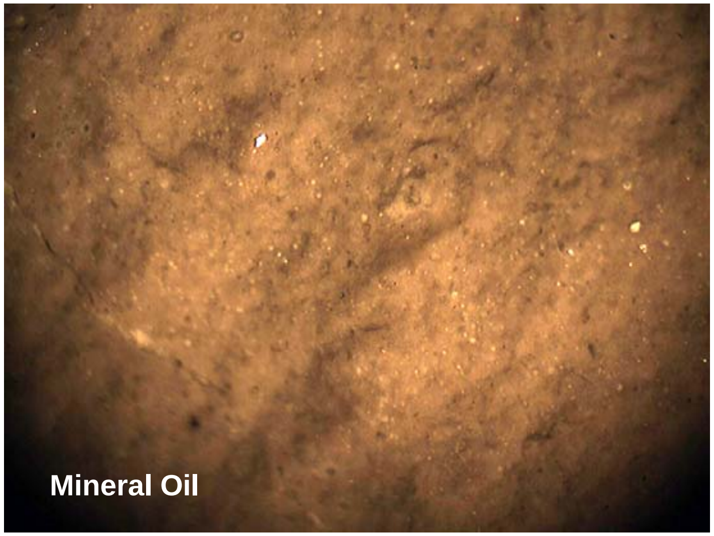
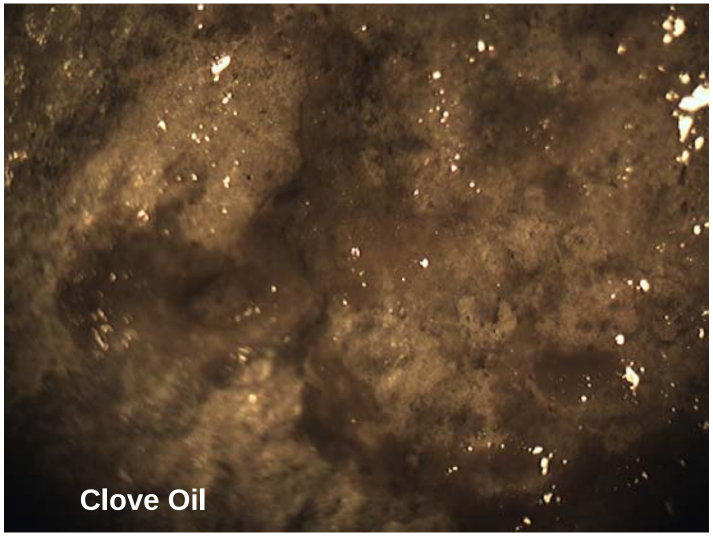
Wetting - Carbonates

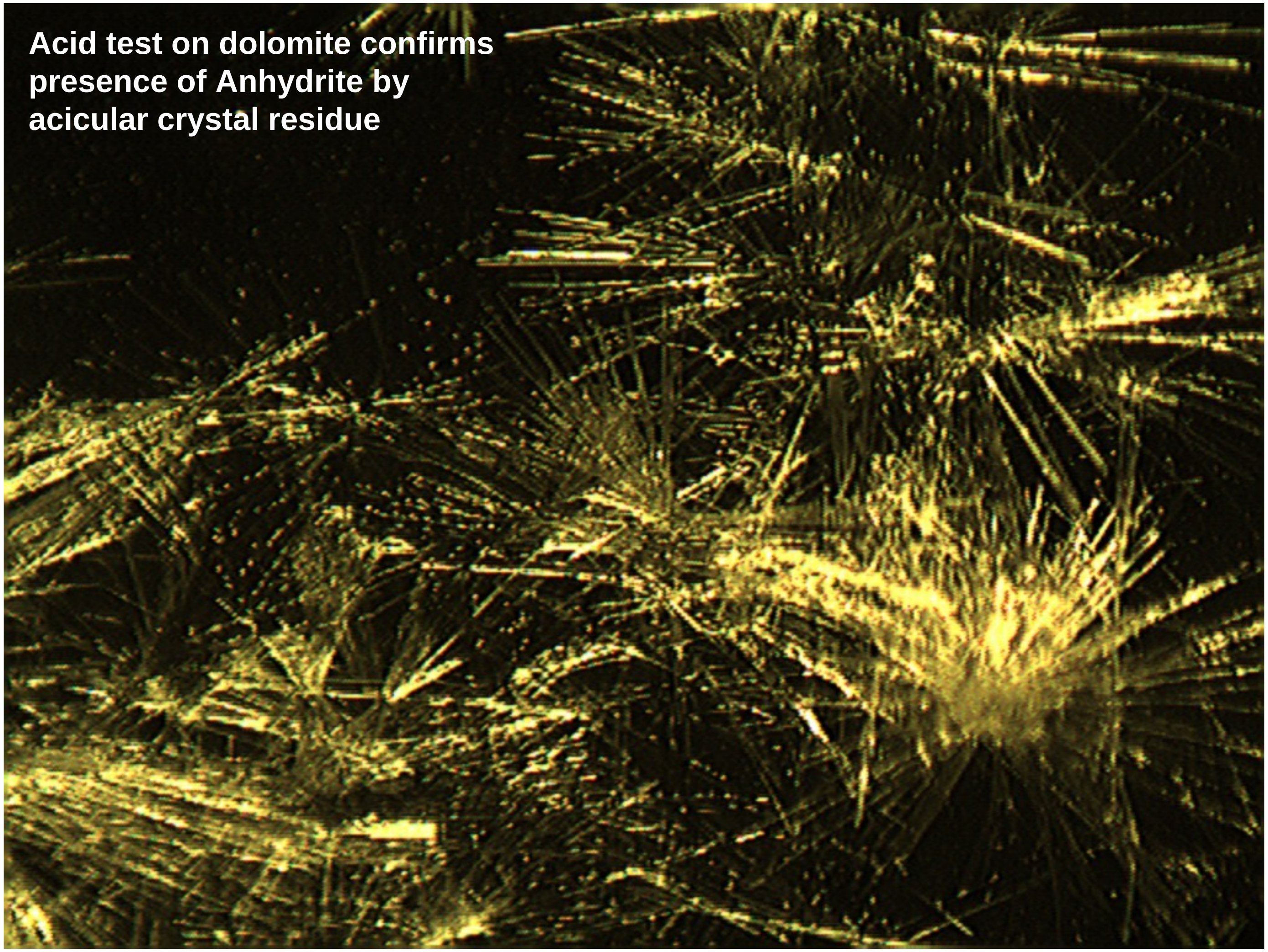








Anhydrite Crystals



Rock Builders

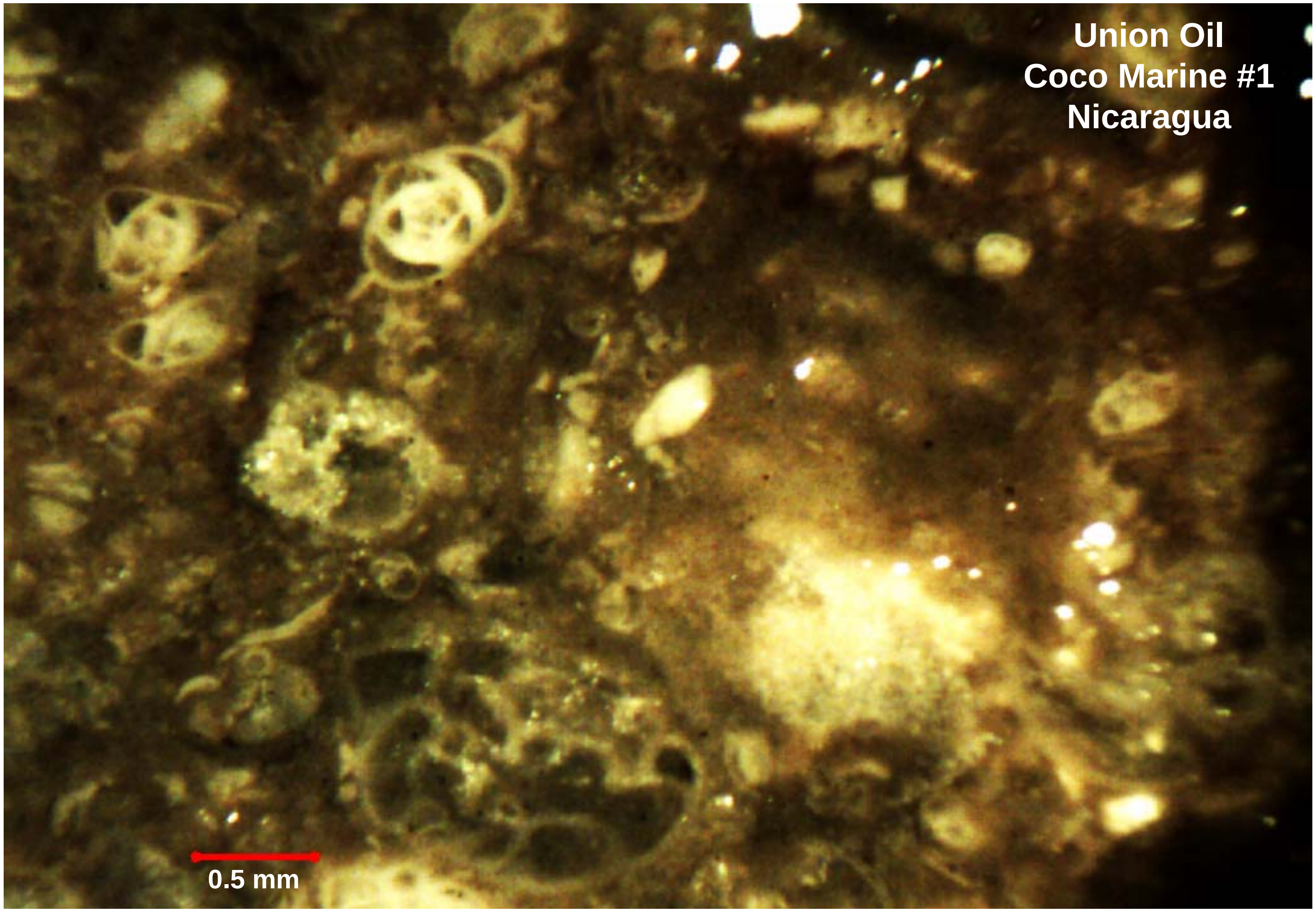
Genus *Girvanella*

1. **Probably a green algae.**
2. **Tubes of uniform diameter, usually thick, well-defined walls. Tubes are simple cylinders without cross partitions or perforations in the side walls.**
3. **Range: Cambrian – Cretaceous.**

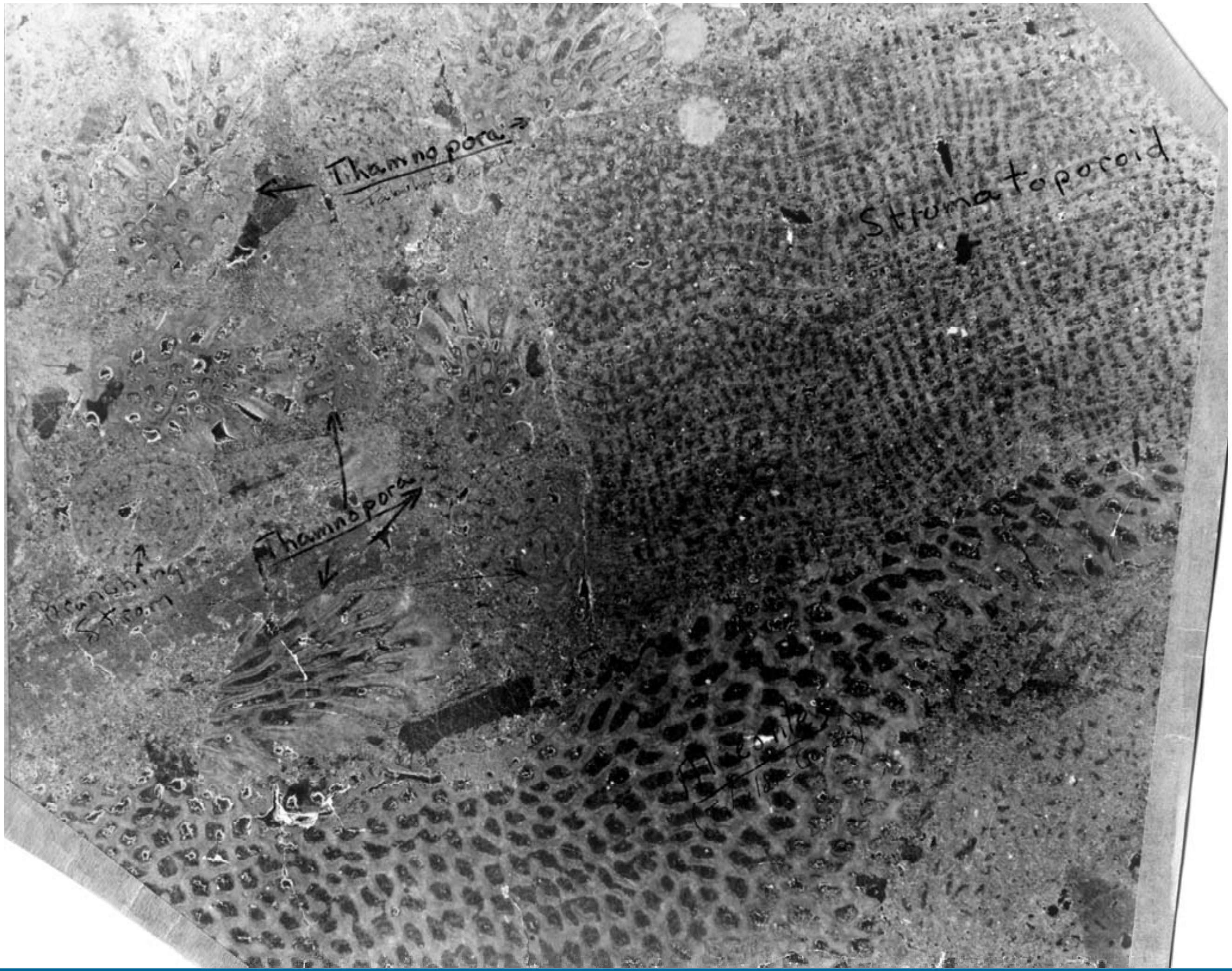
Solenoporaceae

1. **Long considered an algae, now is thought to be a chaetetid sponge.**
2. **Similar to coralline algae, but no sporangia or conceptacles are present; differentiation of tissue into hypothallus and perithallus does not occur.**
3. **Range: Ordovician to Cretaceous; abundant in Jurassic**

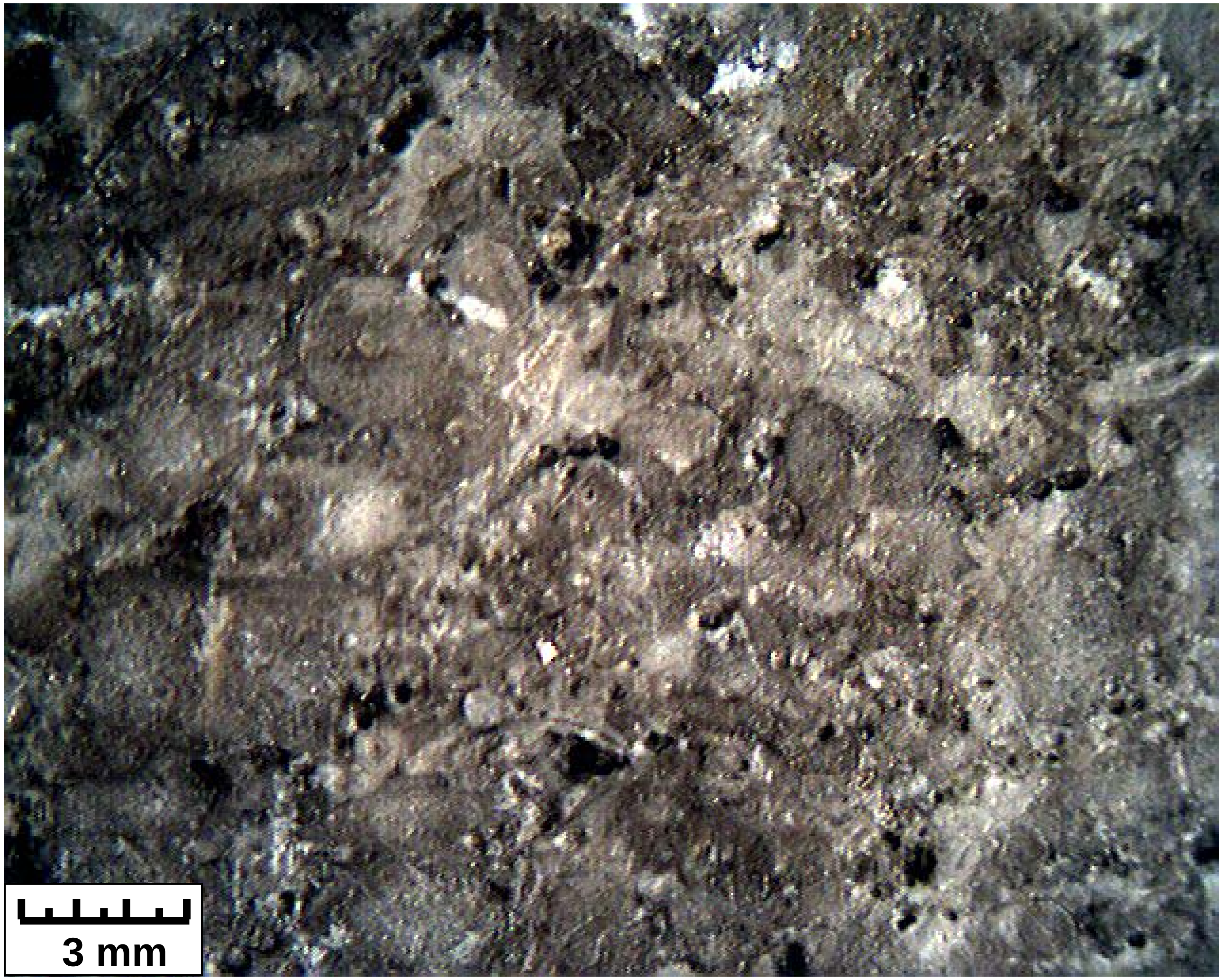
Foraminifera Limestone with Clove Oil



Thamnopora & Stromatoporoid



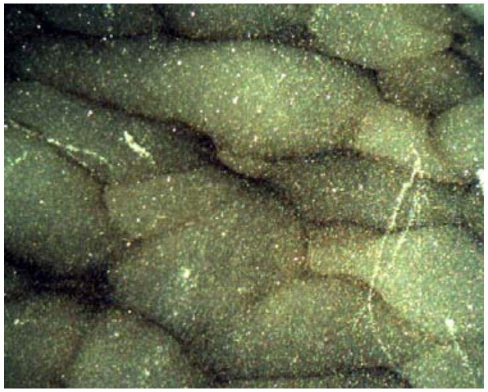
Crinoids



Anhydrite

Primary Anhydrite

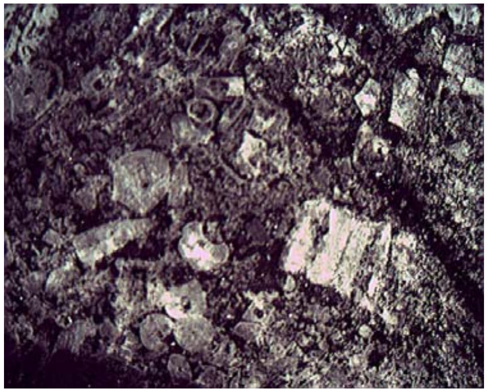
Interbedded Anhydrite and Dolomite



Nodular Anhydrite: Mosaic or Chicken–wire Structure

Secondary Anhydrite

Metasomatic replacement of limestone



Secondary Anhydrite cementing and replacing dolomitized limestone.