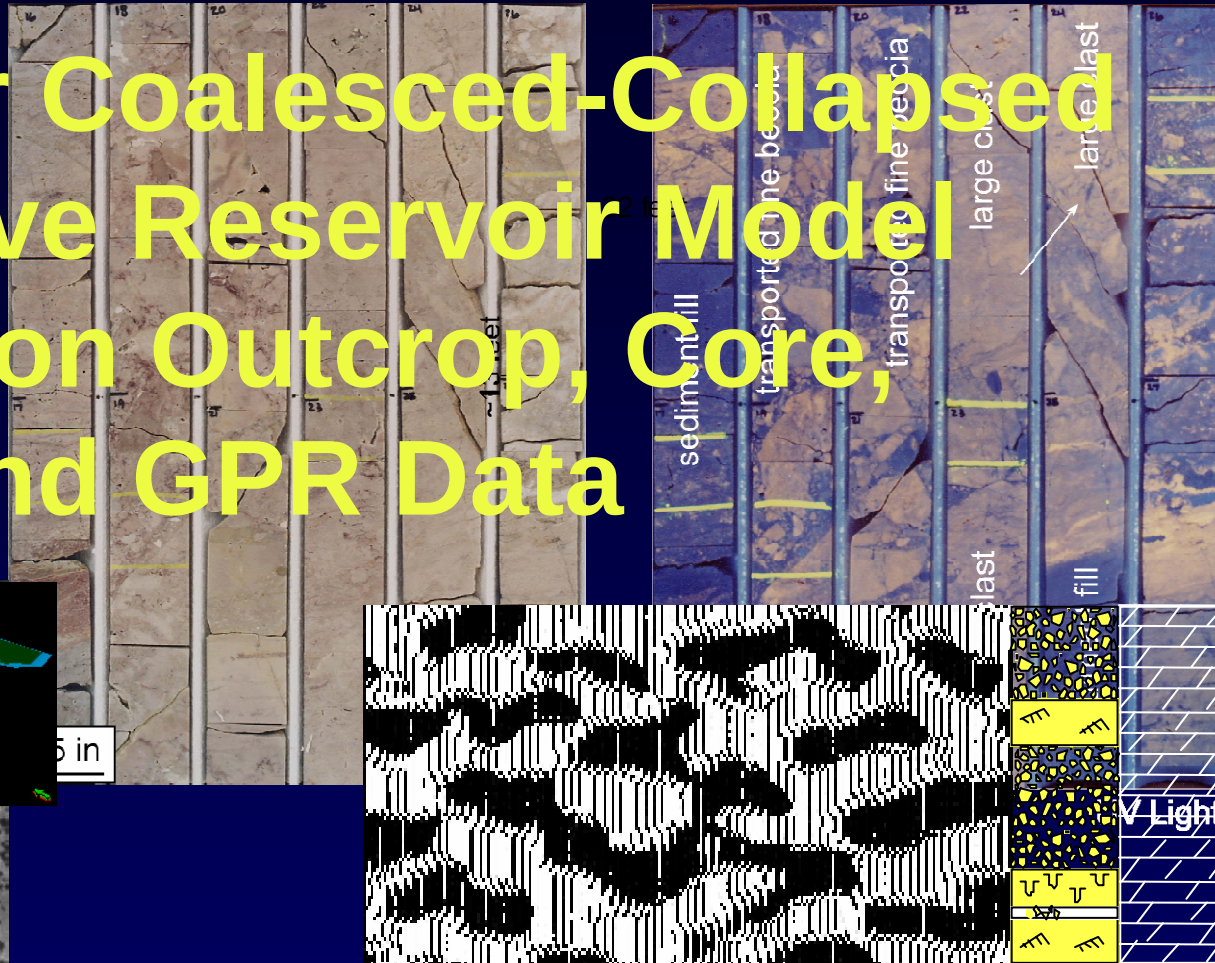
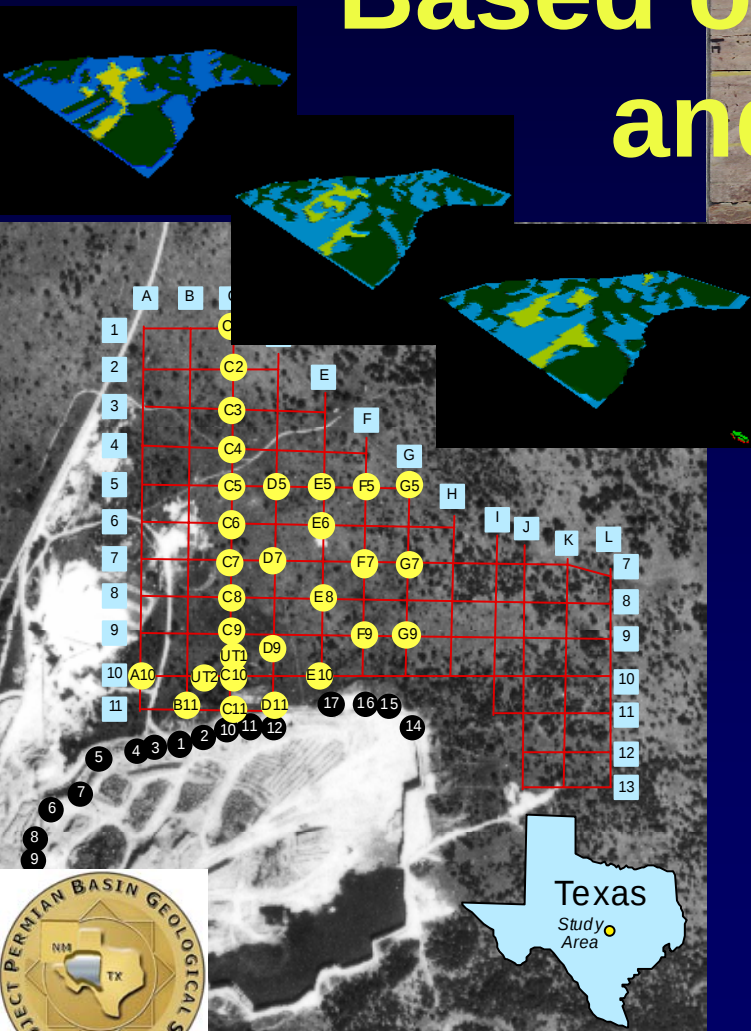


Ellenburger Coalesced-Collapsed Paleocave Reservoir Model Based on Outcrop, Core, and GPR Data

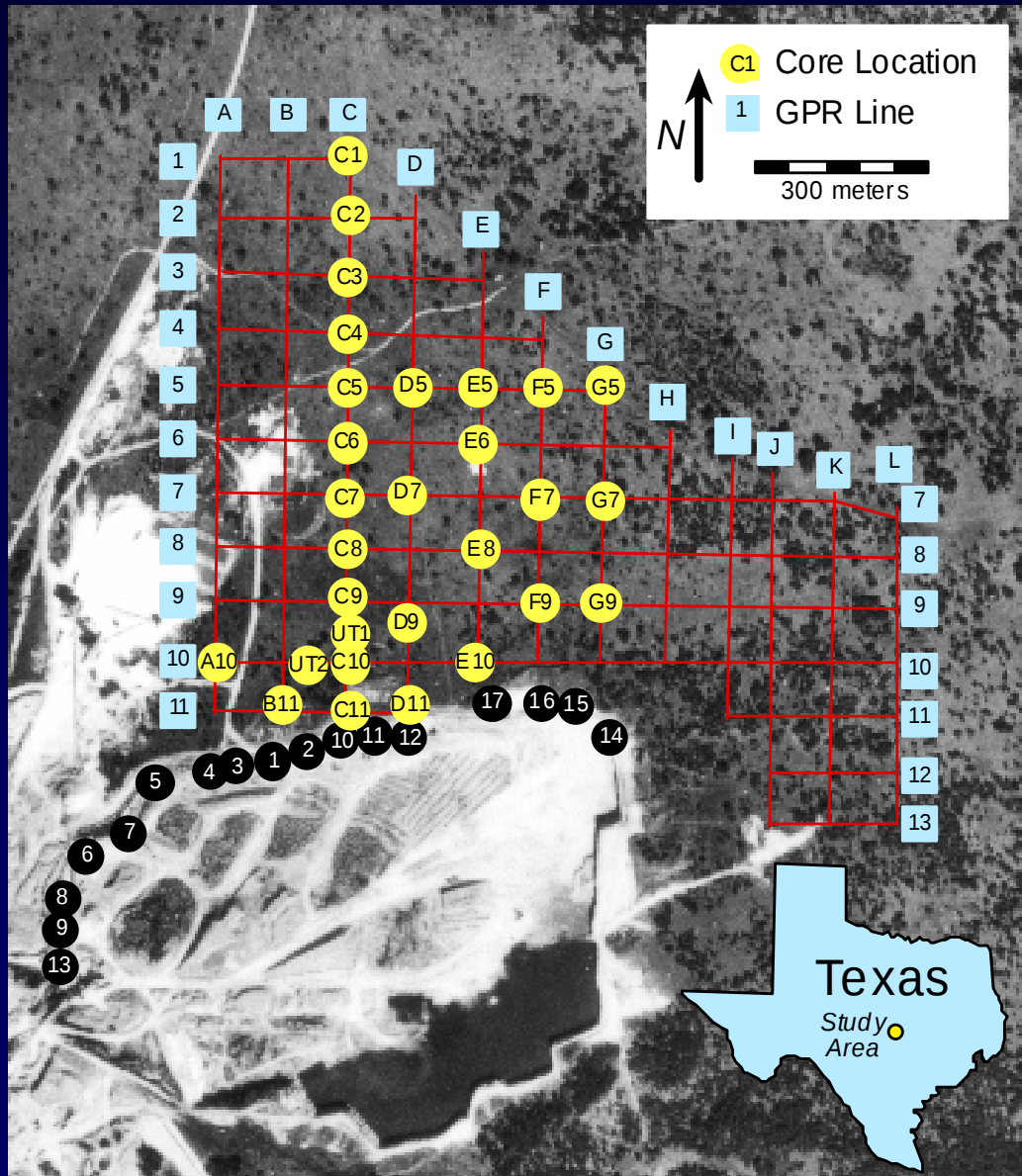


Fred Wang and Bob Loucks
Bureau of Economic Geology
Jackson School of Geosciences
The University of Texas at Austin

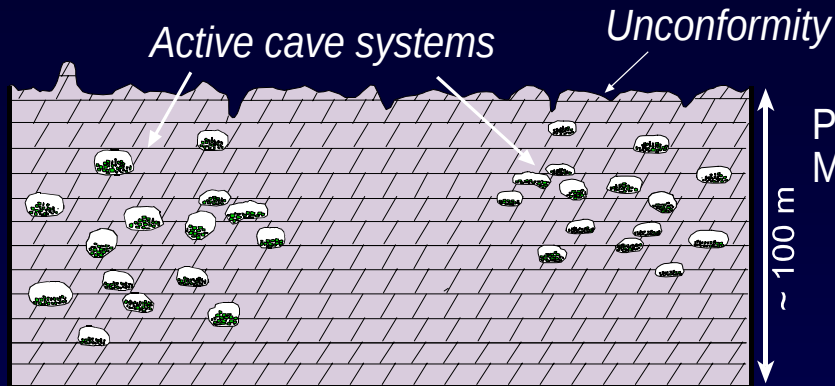
Outline

- Present study area
- Show megascale paleocave collapse features
- Map of paleocave facies
- Reservoir model

Study Area



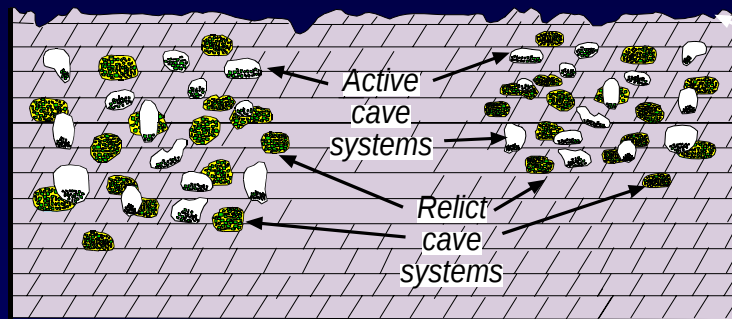
Cave-System Evolution



Phase 1:
Modern cave system

Phase 2:
Multiple near-surface cave systems
developed at composite unconformity

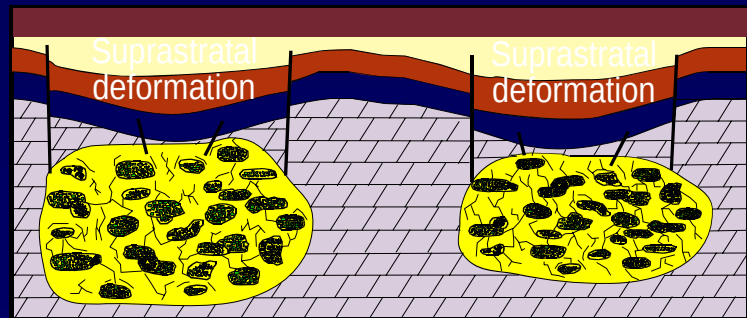
Long-term
exposure



Composite
unconformity

Phase 3:
Coalesced, collapsed-
paleocave system

Burial and
collapse

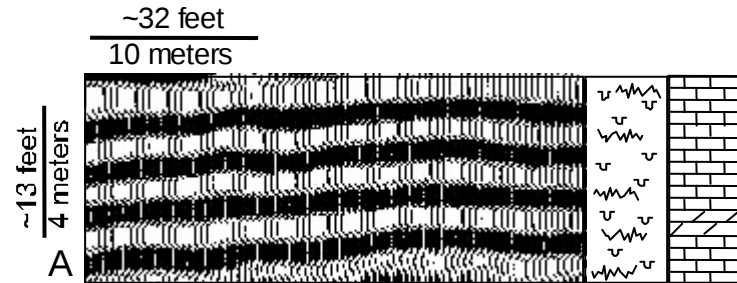


100 to >1000 m

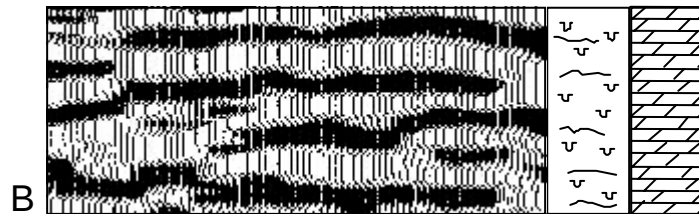
EXPLORATION TARGETS

GPR Facies

Undisturbed
host rock



Disturbed
host rock

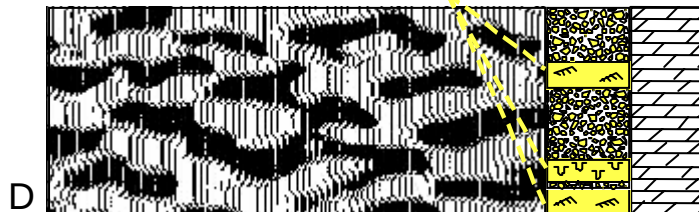


Coarser-clast
dominated
brecciated rock

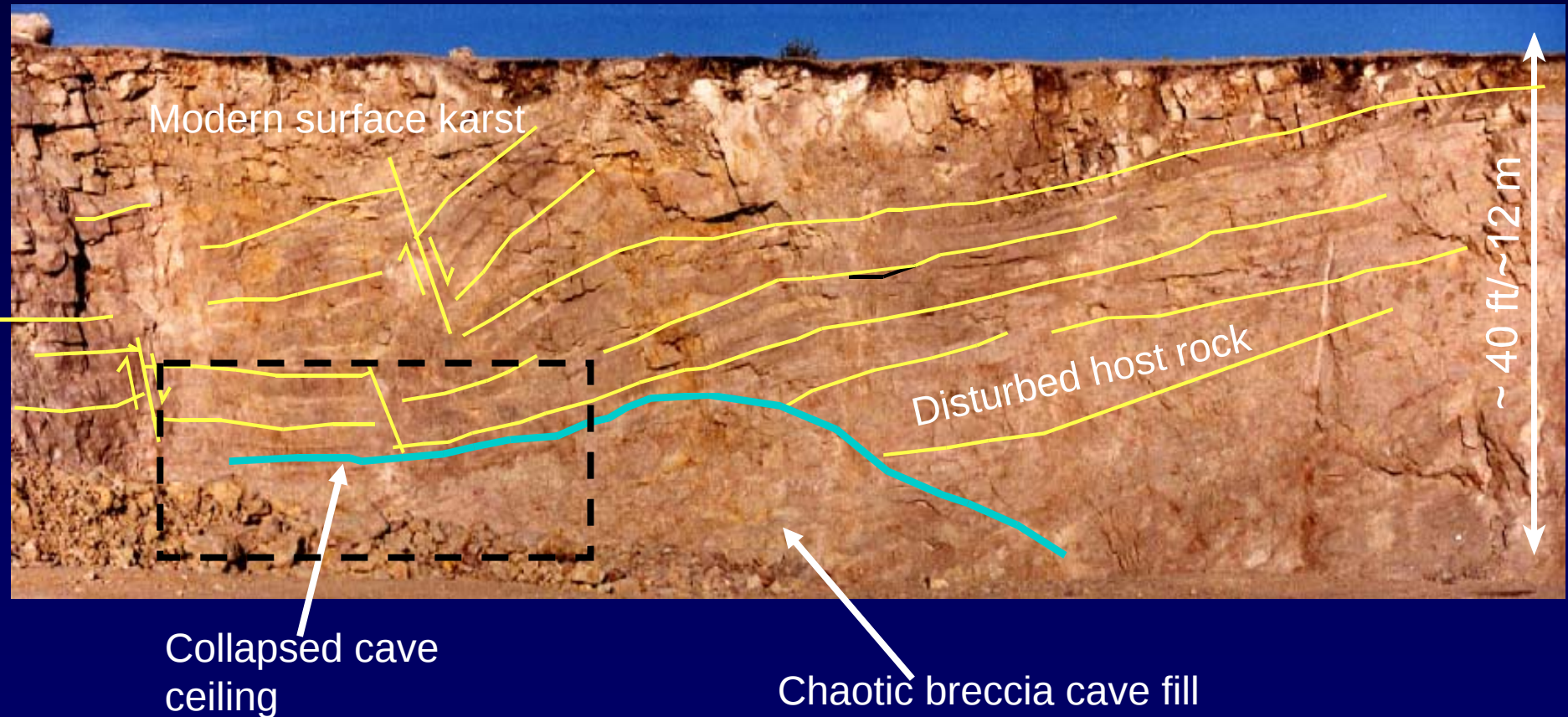


Blocks or slabs

Finer-clast
dominated
brecciated rock

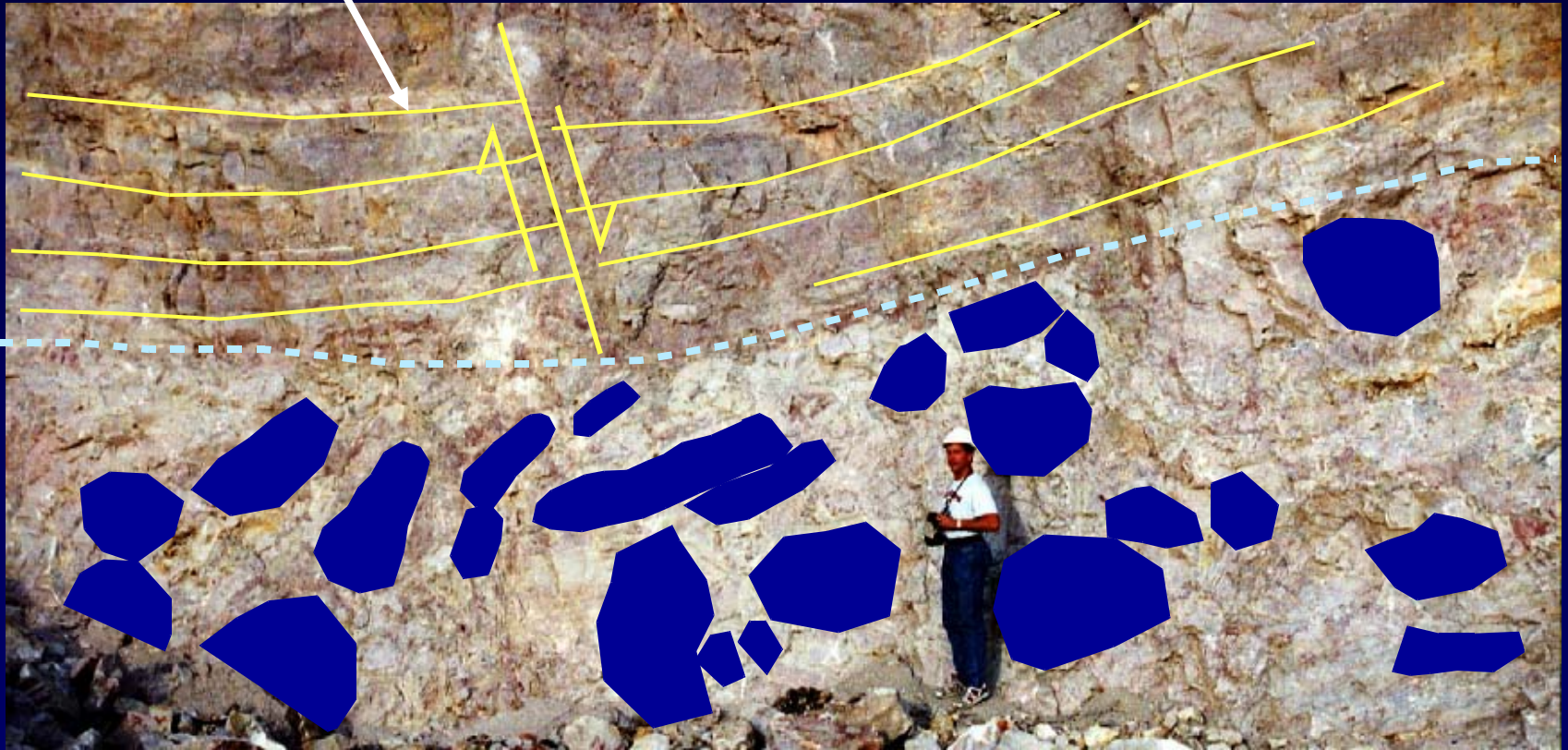


Collapsed Paleocavern

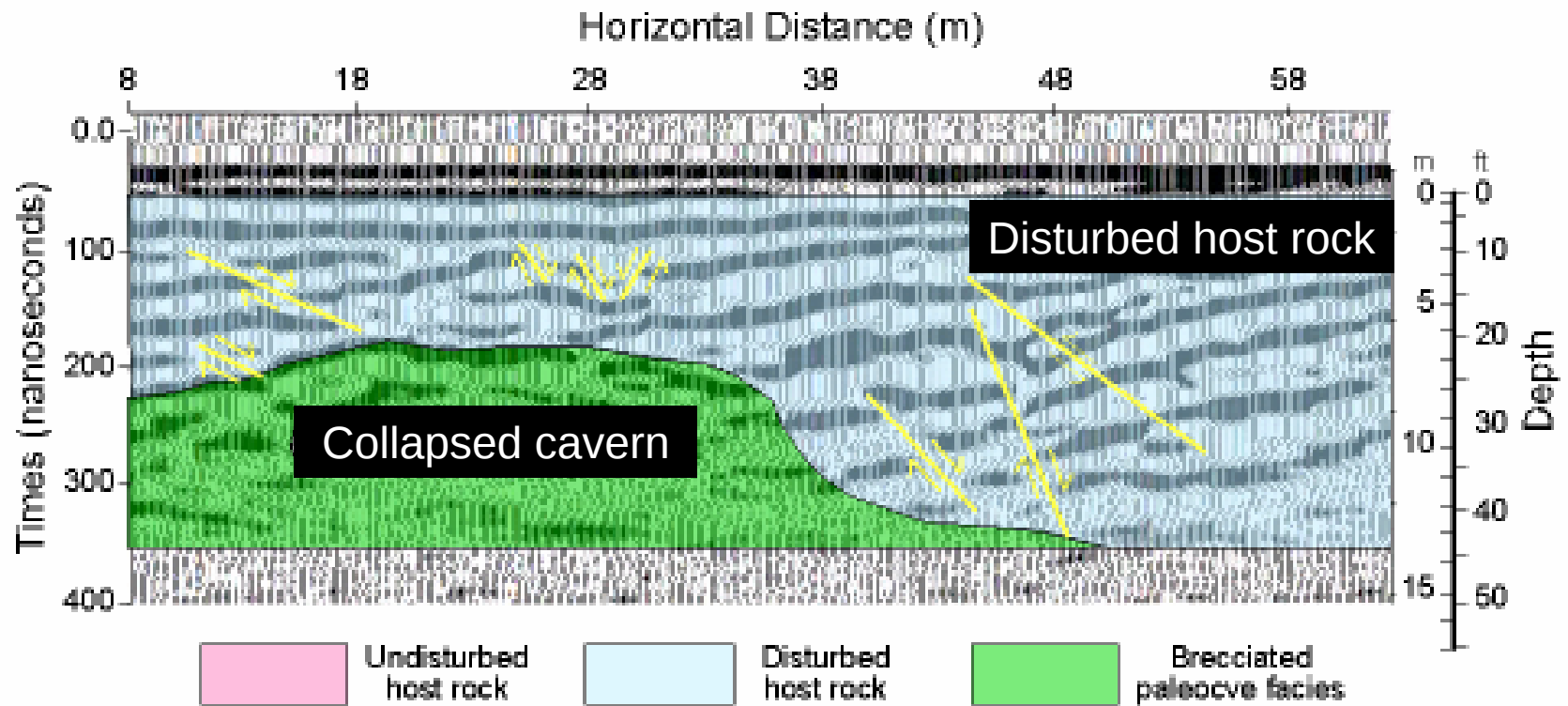


Collapsed Paleocavern

Collapsed cave ceiling

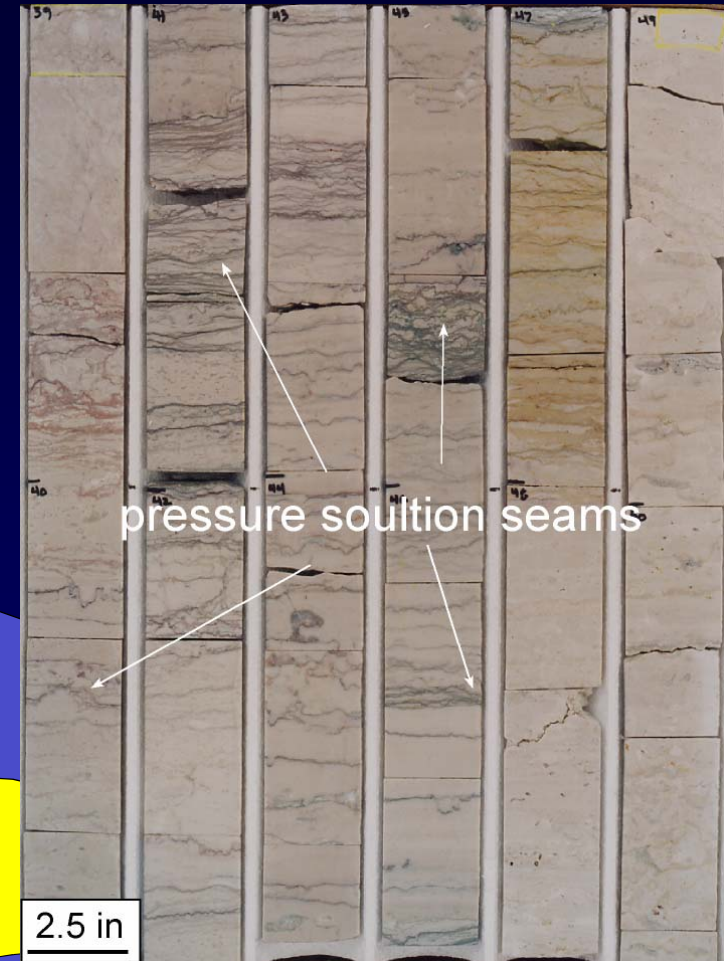
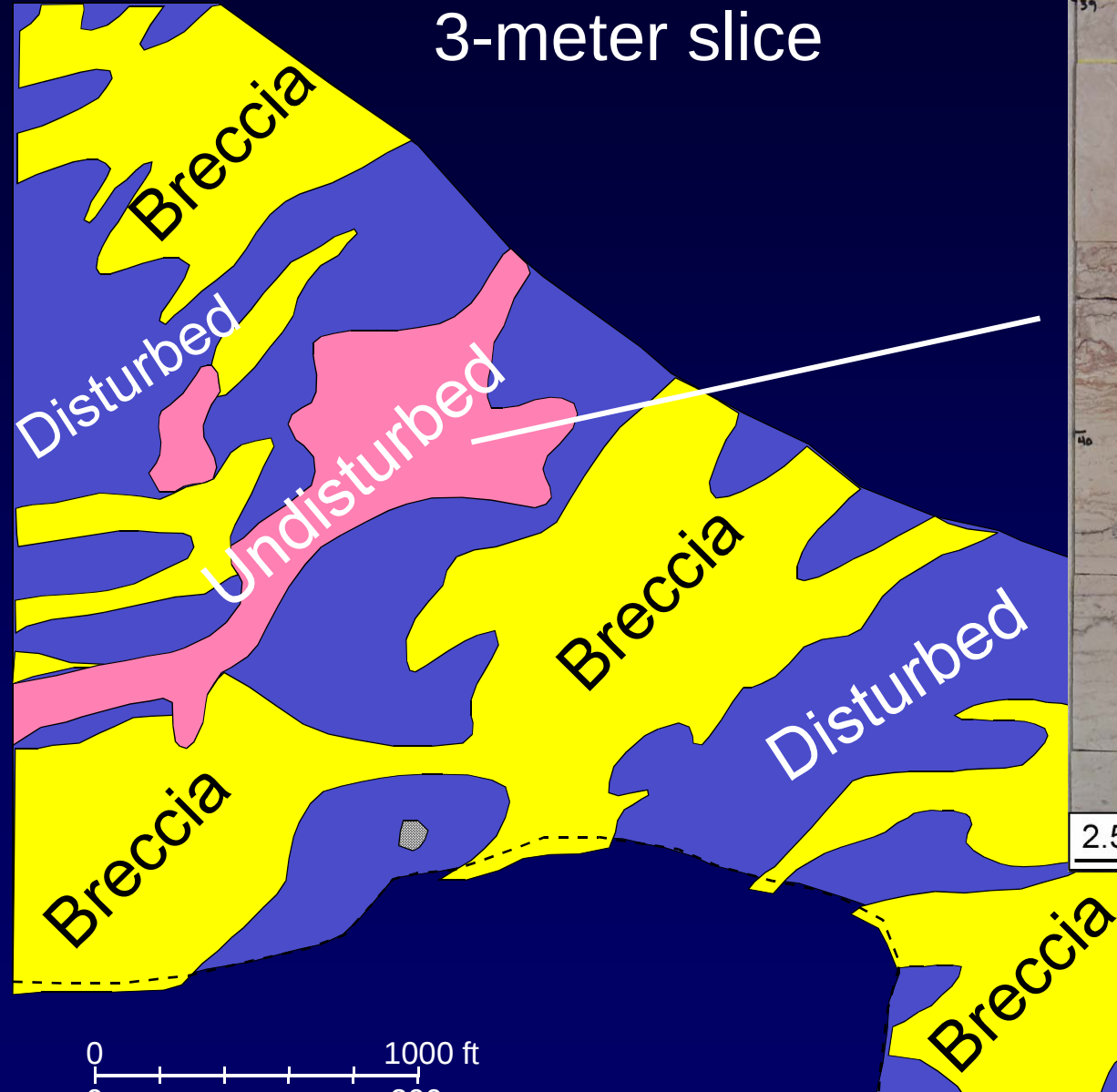


Collapsed Paleocavern



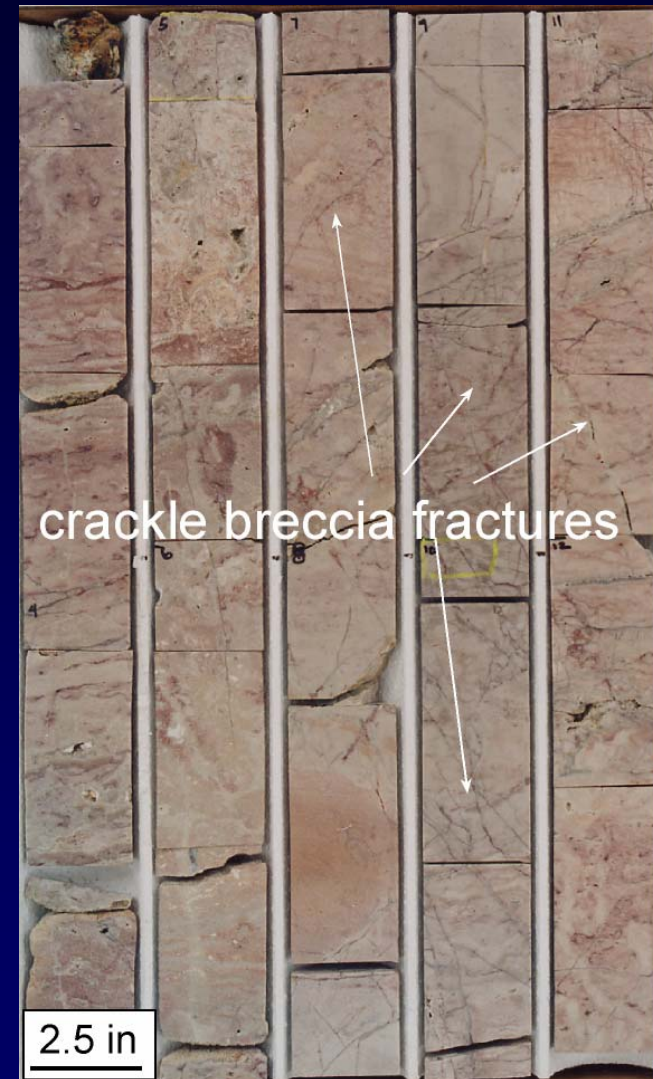
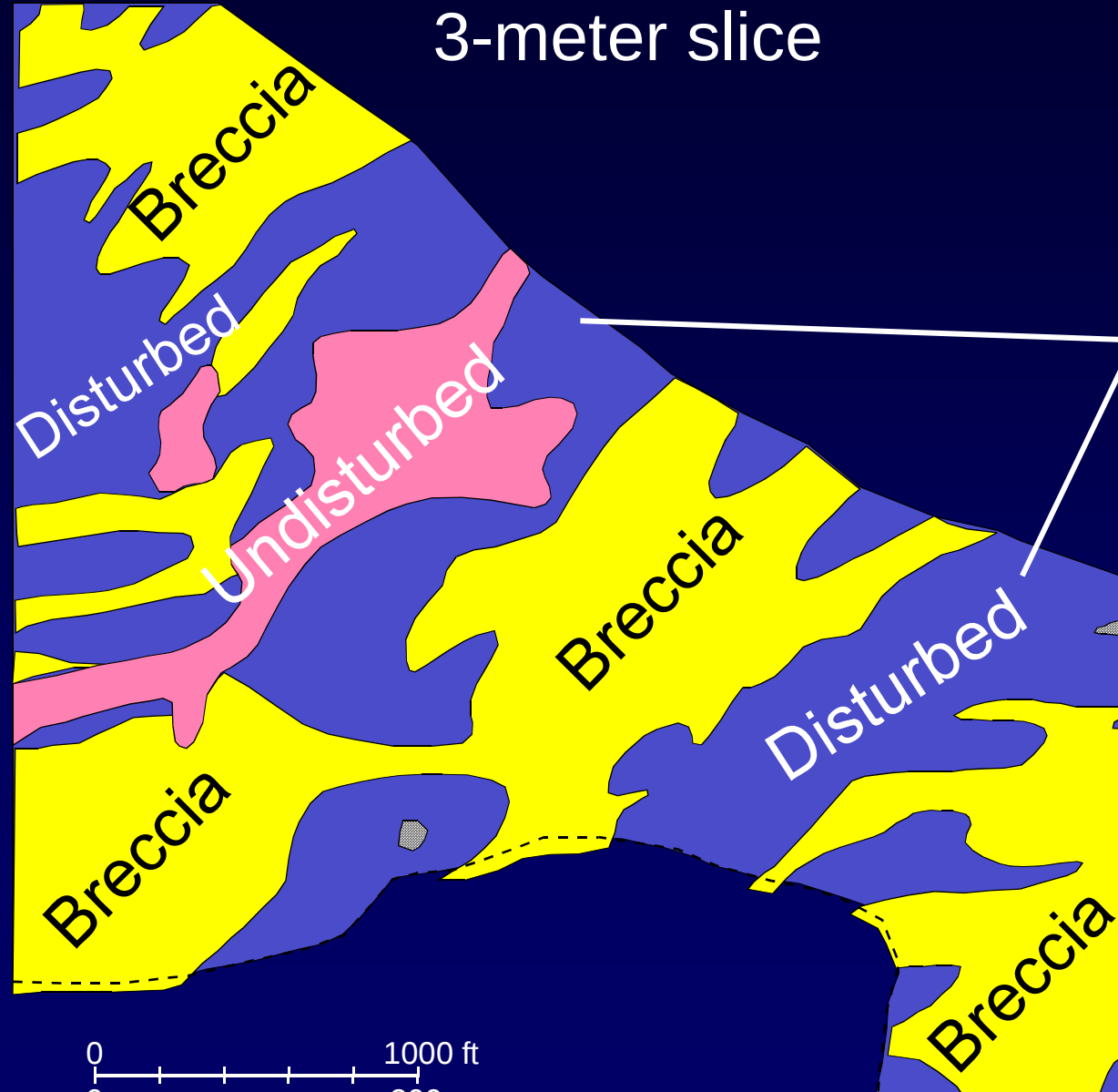
Paleocave Facies

3-meter slice



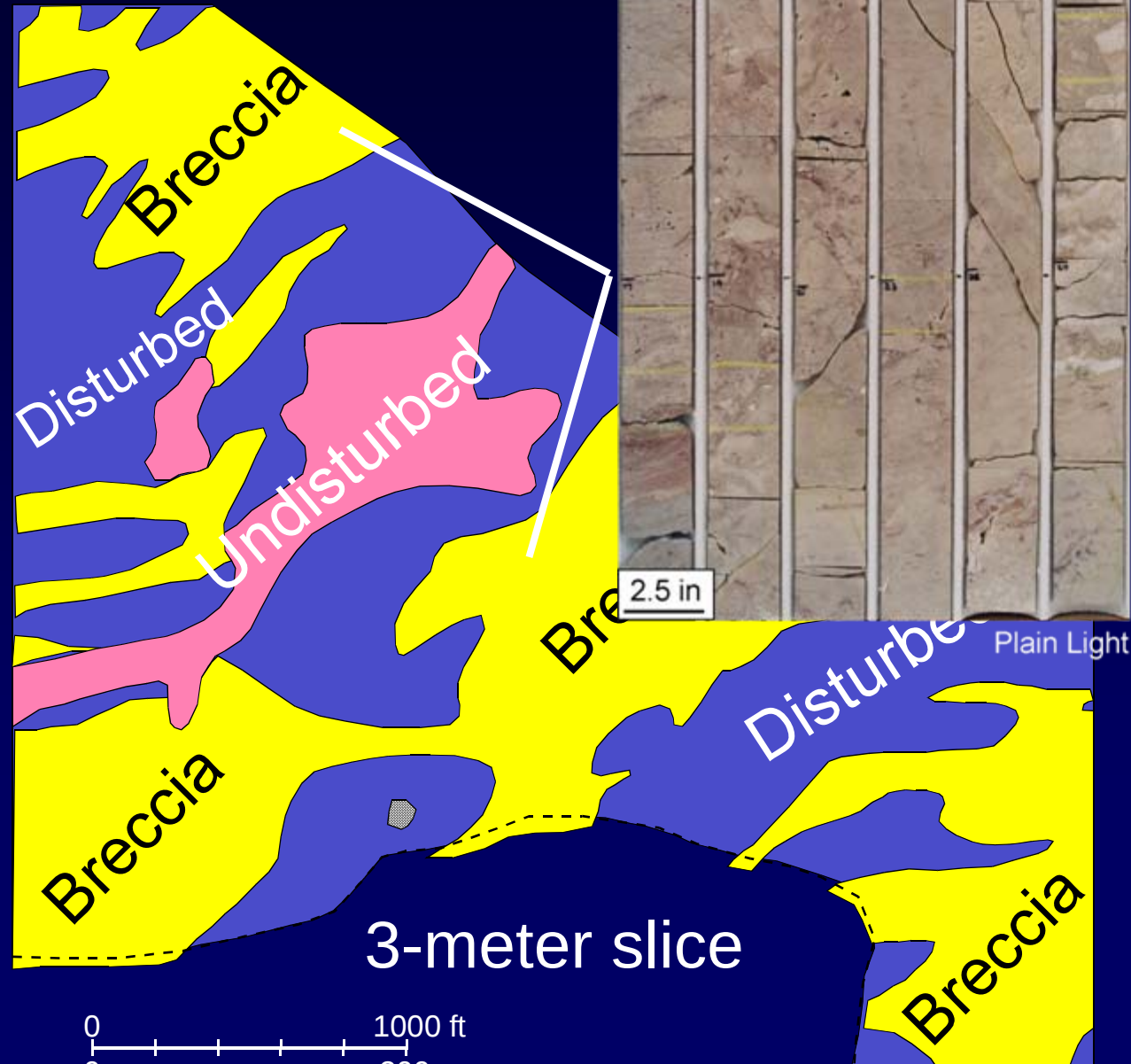
Paleocave Facies

3-meter slice

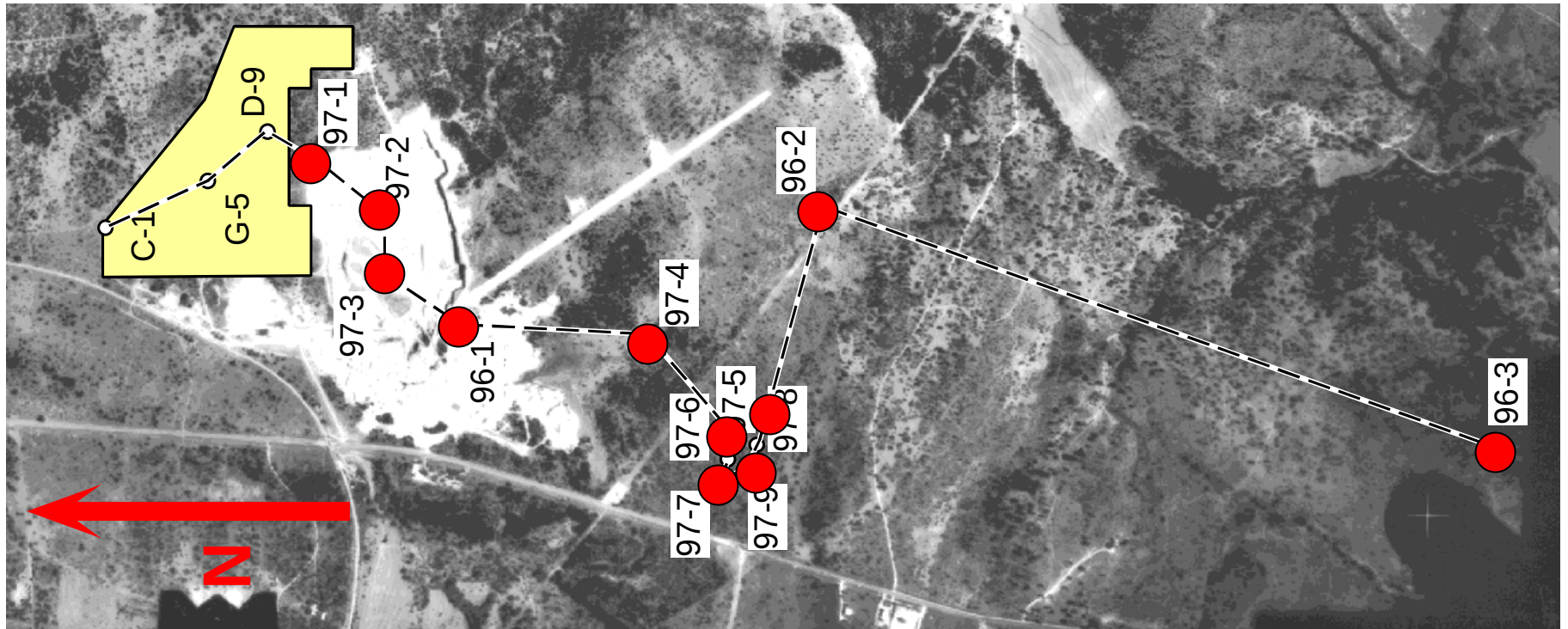


Loucks (1999)

Paleocave Facies

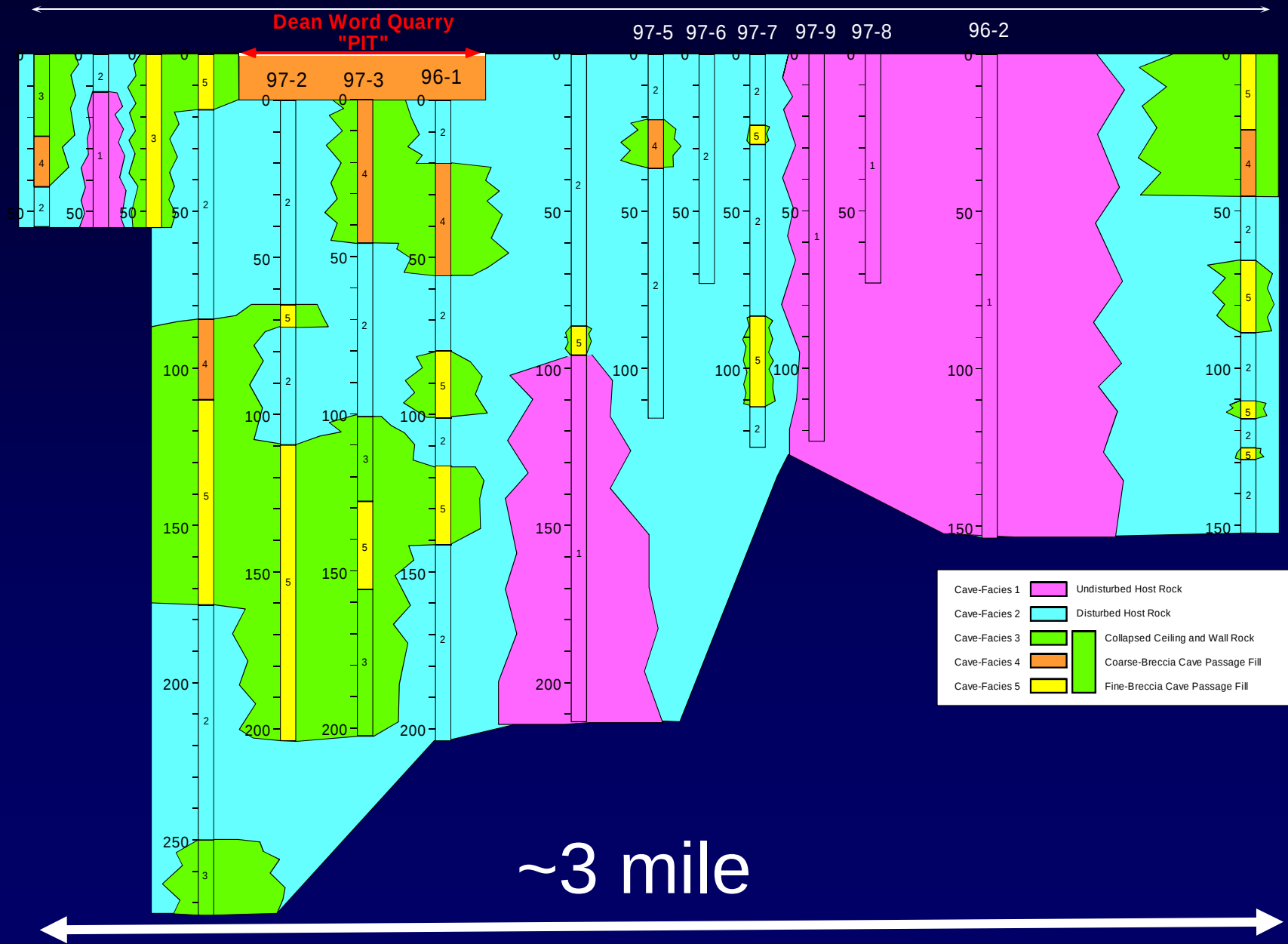


Extended Study Area

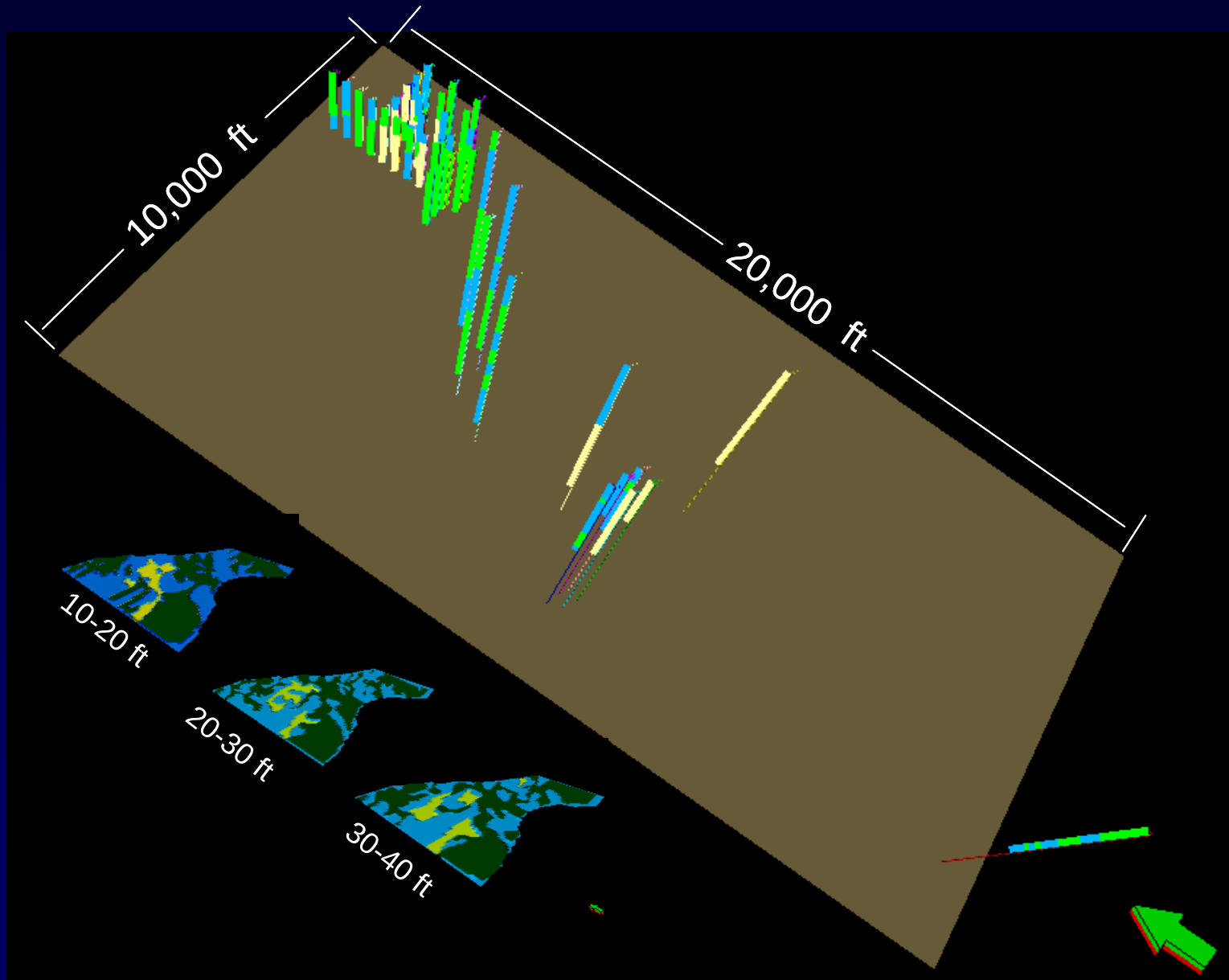


1 mile

Extended Study Area



Well & Facies Control



Stochastic Facies Modeling

Sequential Indicator Simulation

Well Controls 41

GPR Facies 3

Model Dimensions

10,000 ft x 20,000 ft x 250 ft

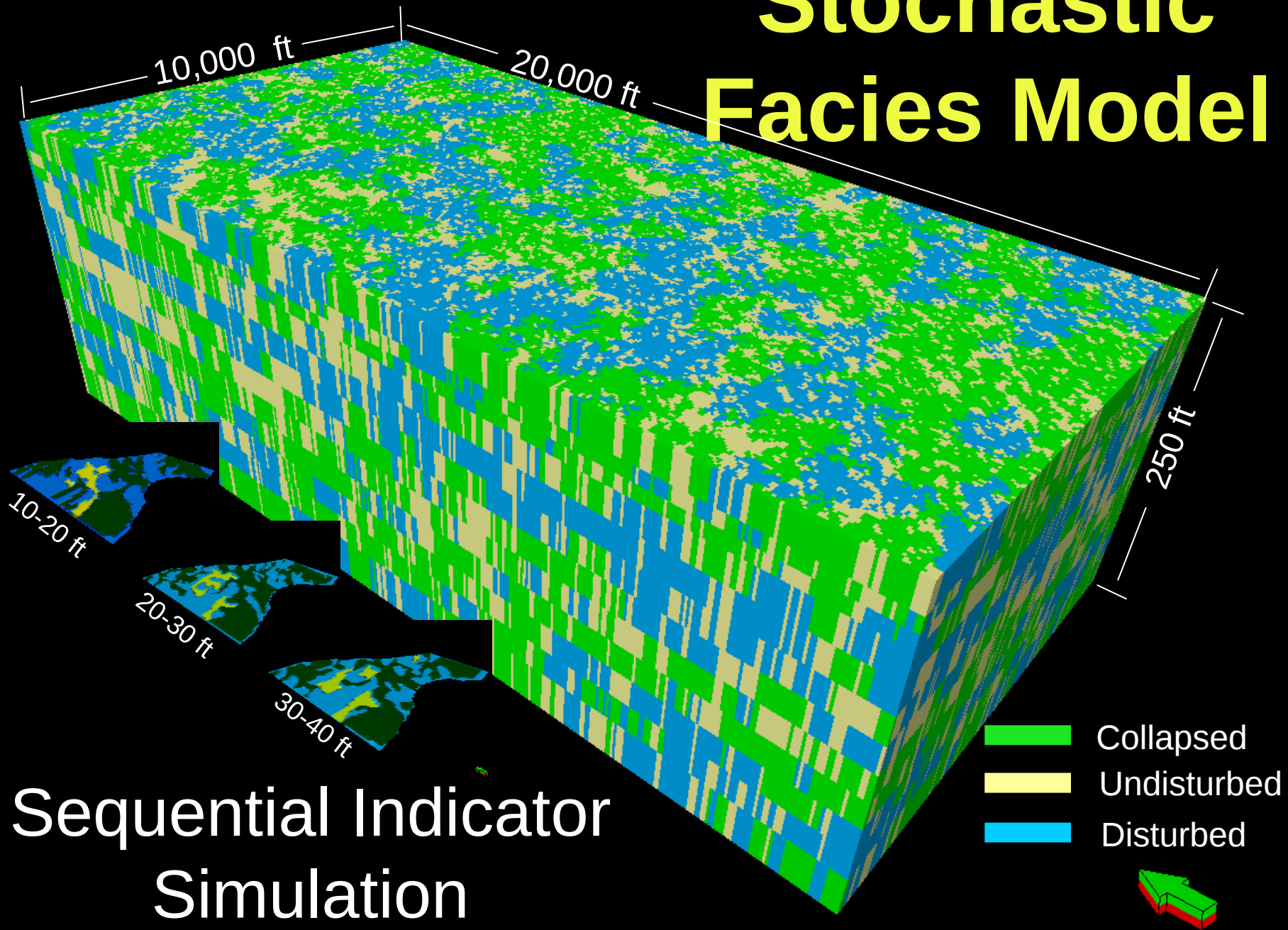
200x400x12 (50 ft x 50 ft x 20-30 ft)

1.5 M cells

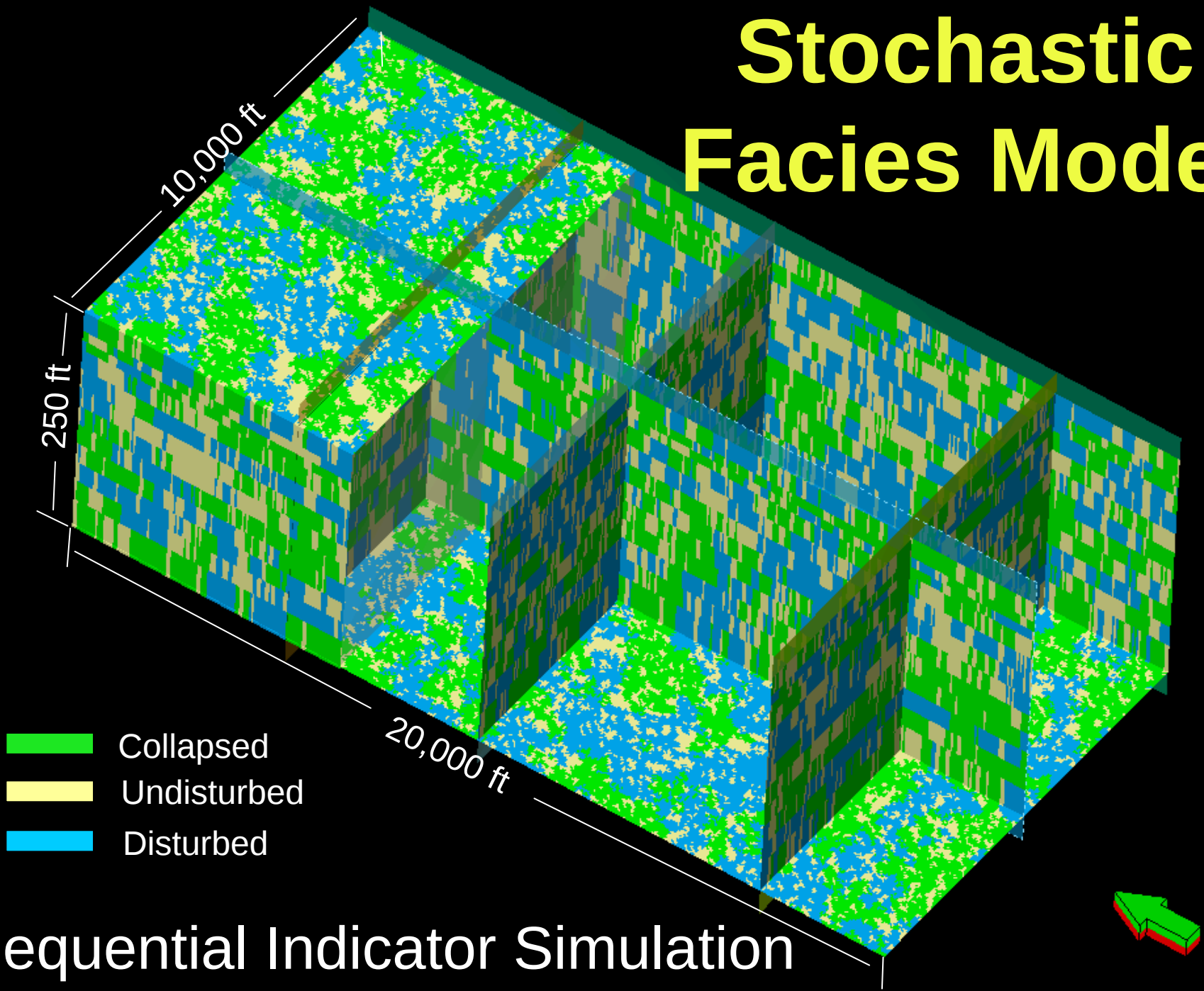
Simulation Parameters

Facies	Ranges (ft)		Angle
	Major	Minor	
Collapsed	1,000-5,000	700-3,500	45
Disturbed	1,000-5,000	1,000-5,000	0
Undisturbed	200-1,000	100- 500	45

Stochastic Facies Model

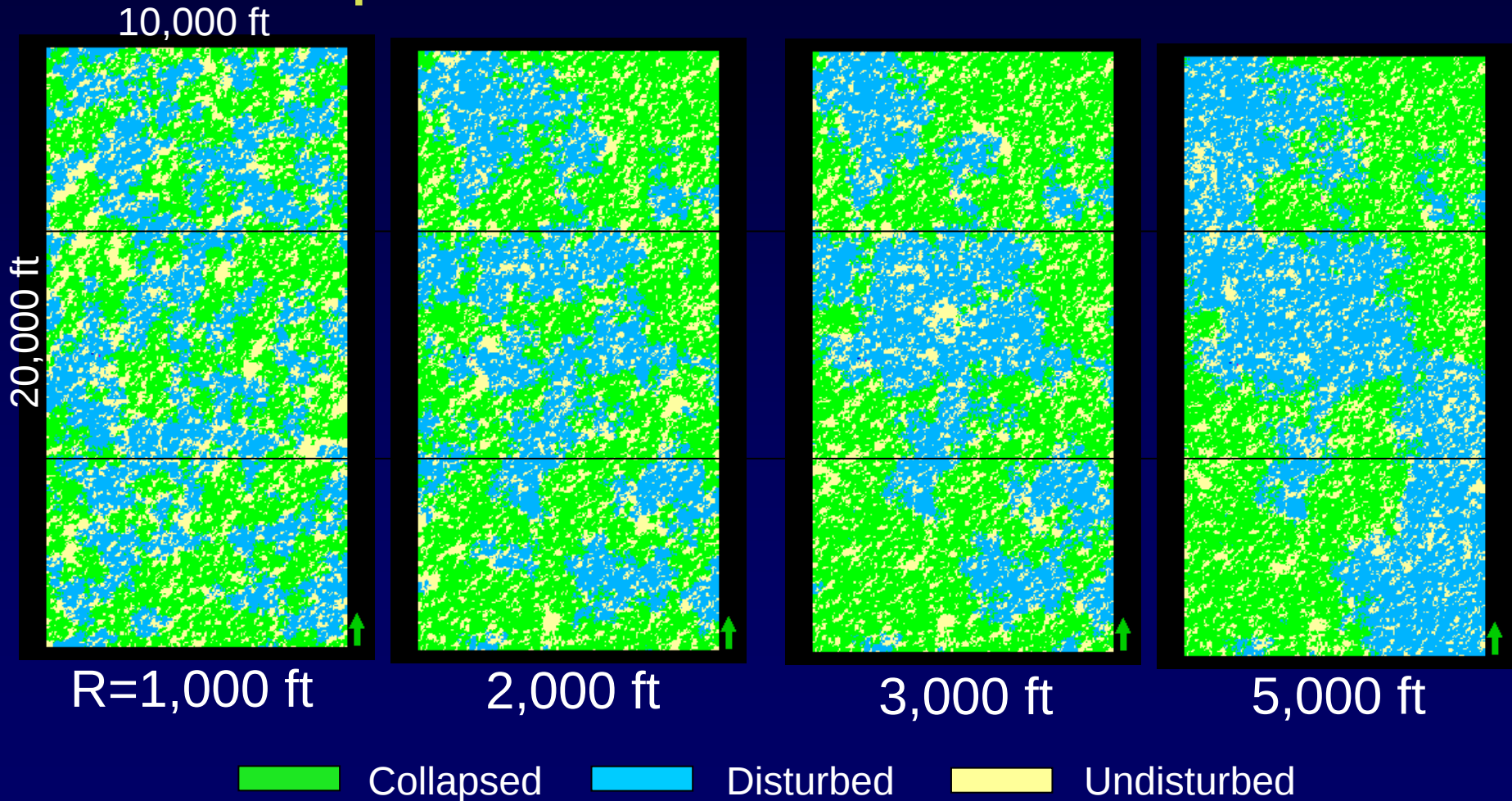


Stochastic Facies Model

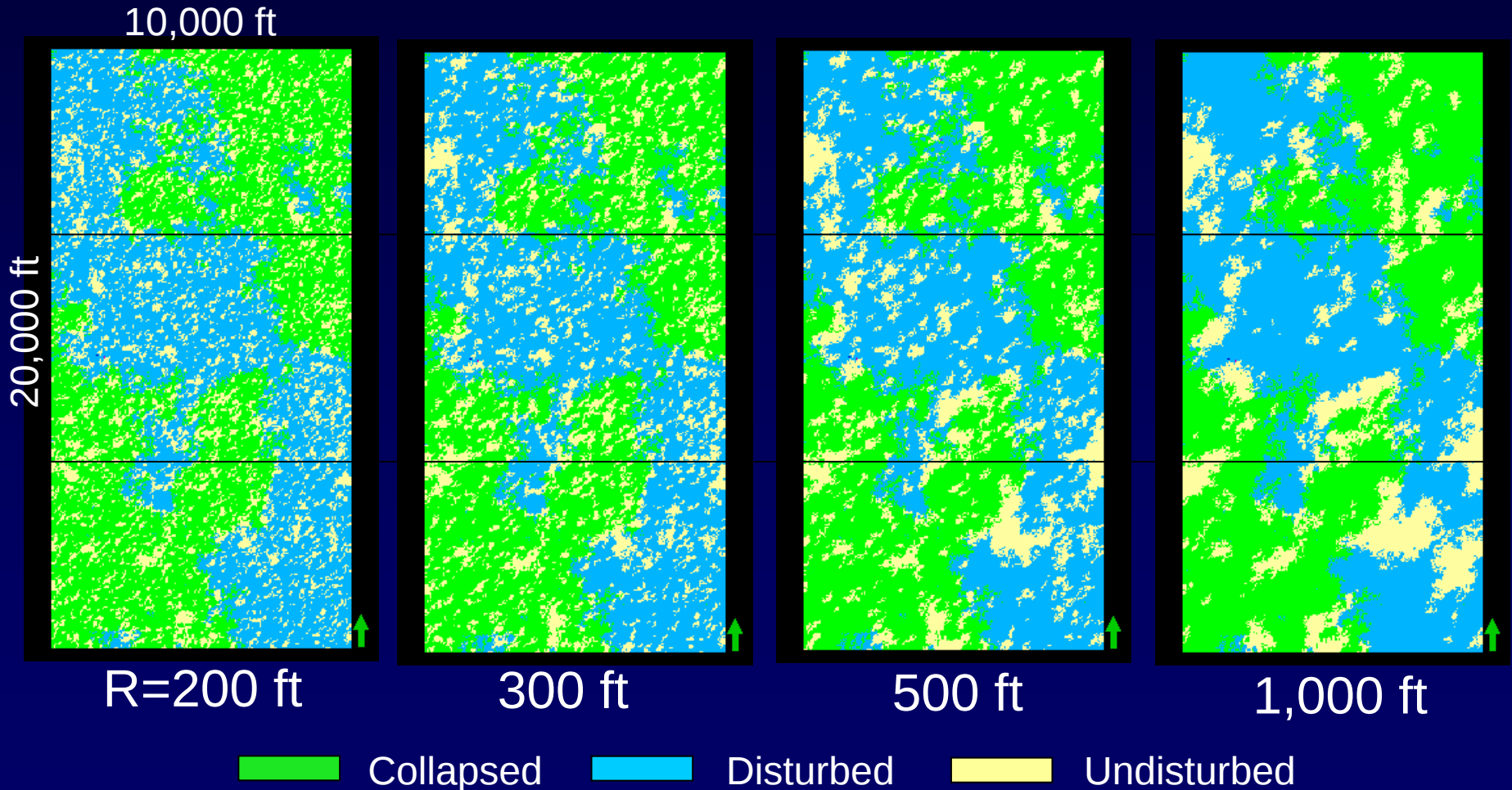


Effect of Correlation Length of Collapsed Facies

Sequential Indicator Simulation



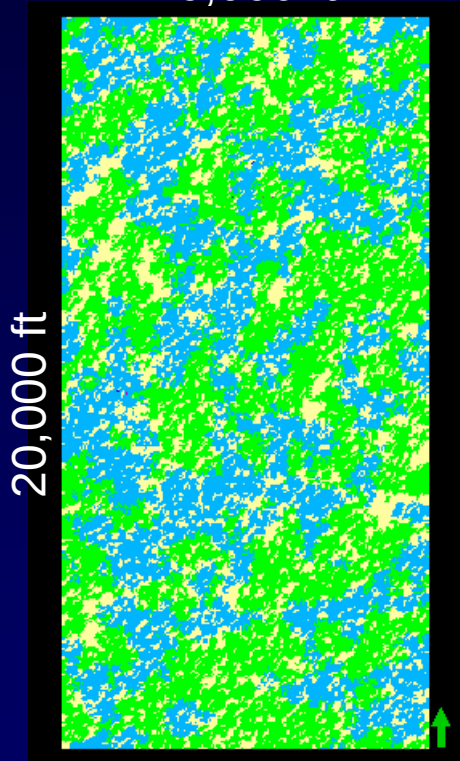
Effect of Correlation Length of Undisturbed Facies Sequential Indicator Simulation



Multi-Step Facies Modeling

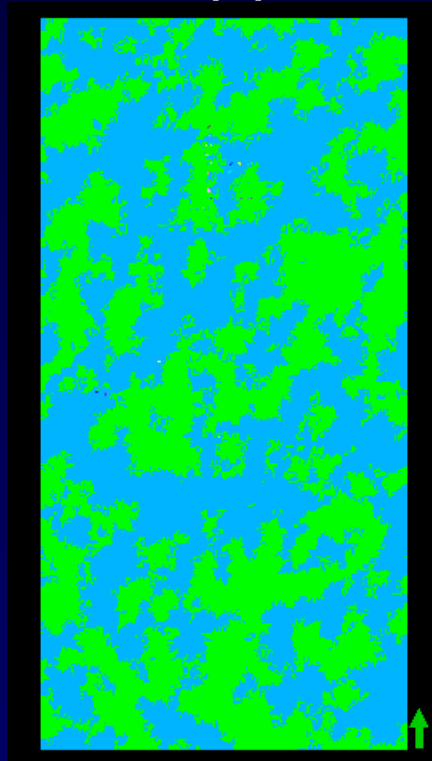
Sequential Indicator Simulation

(1) 10,000 ft



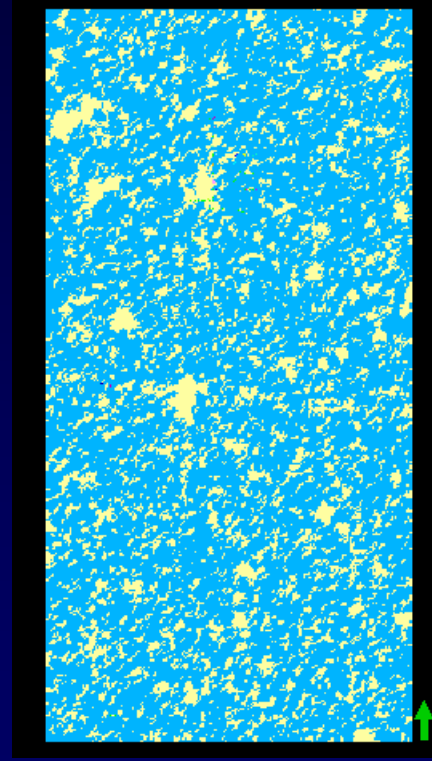
Single Step

(2)



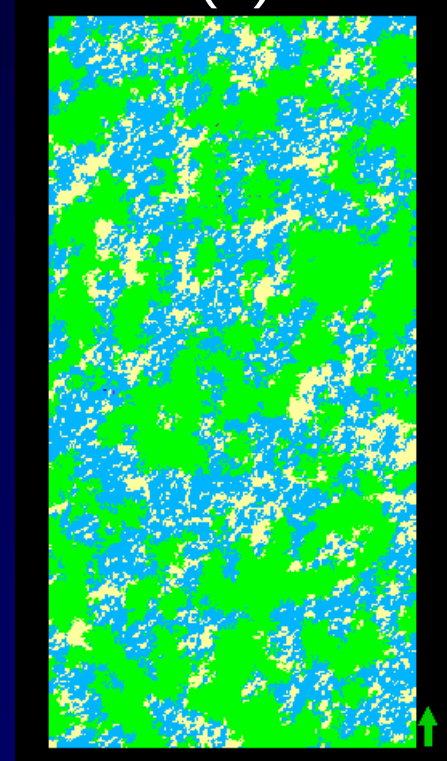
Collapsed +
Disturbed

(3)



Disturbed +
Undisturbed

(4)



Combined

 Collapsed  Disturbed  Undisturbed

Facies in 10-20 Ft Interval

Single-Step Model

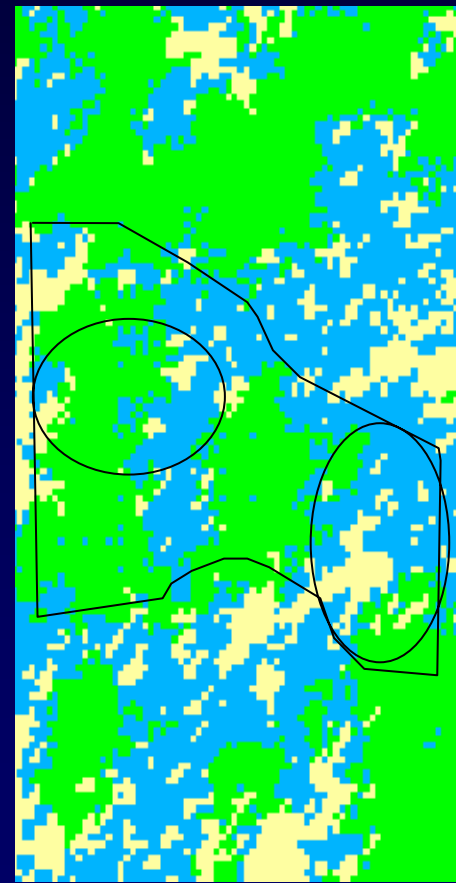
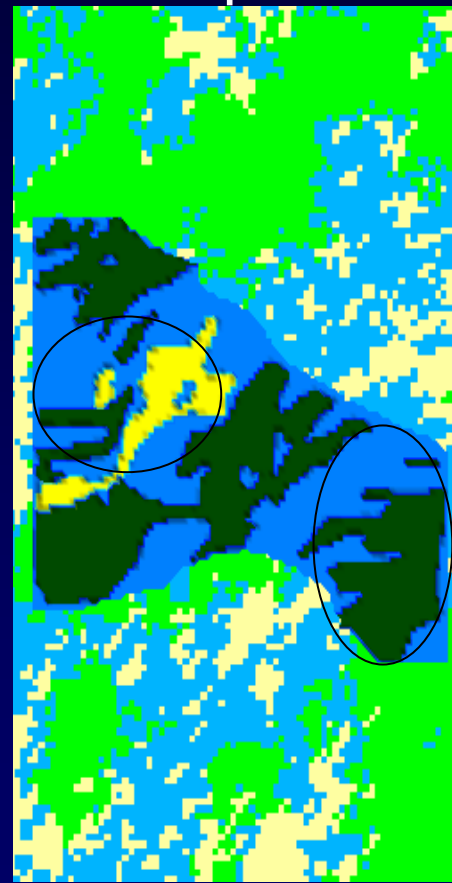
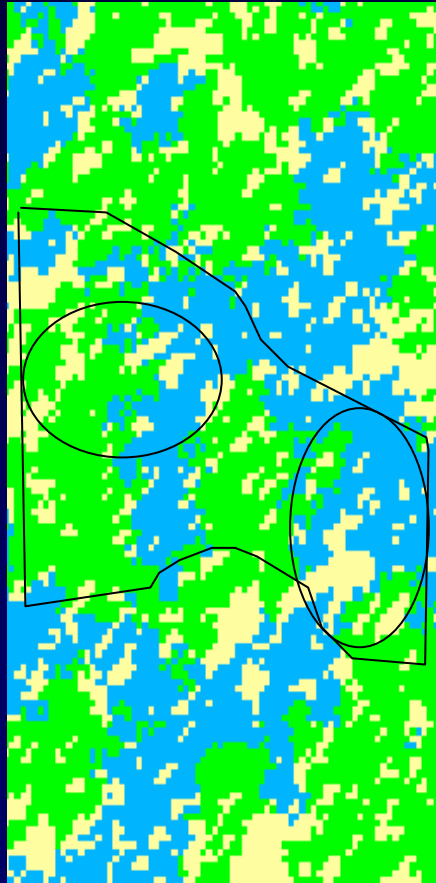
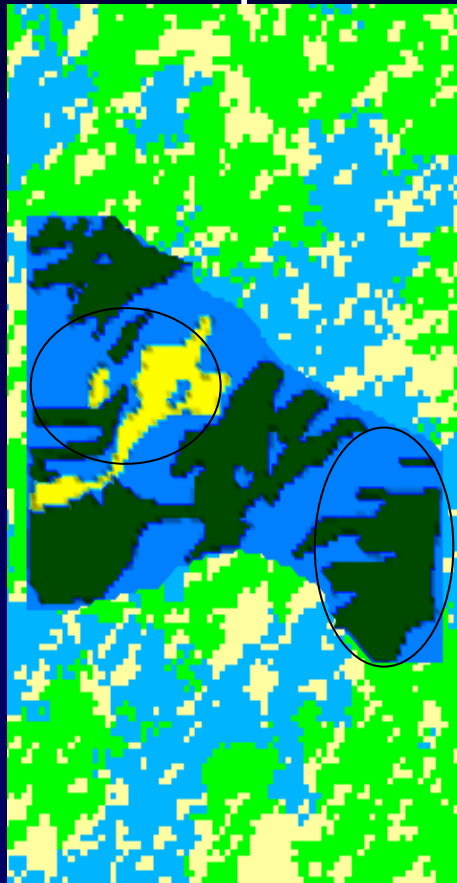
Multi-Step Model

Template

Modeled

Template

Modeled

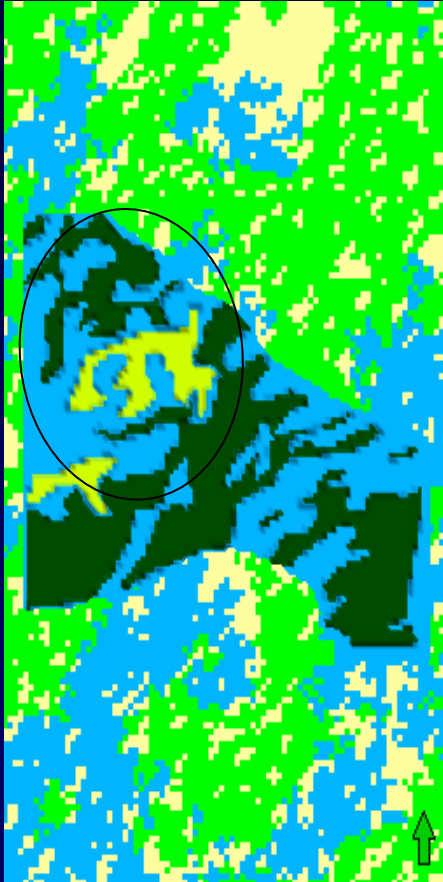


Collapsed Disturbed Undisturbed

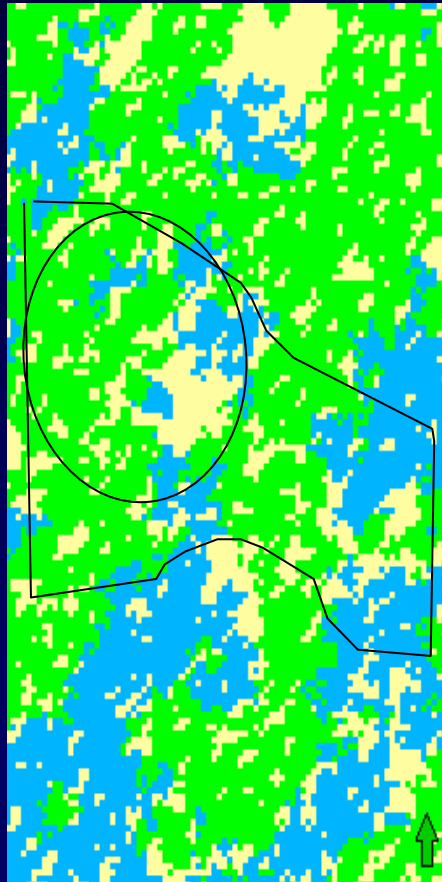
Facies in 20-30 Ft Interval

Single-Step Model

Template

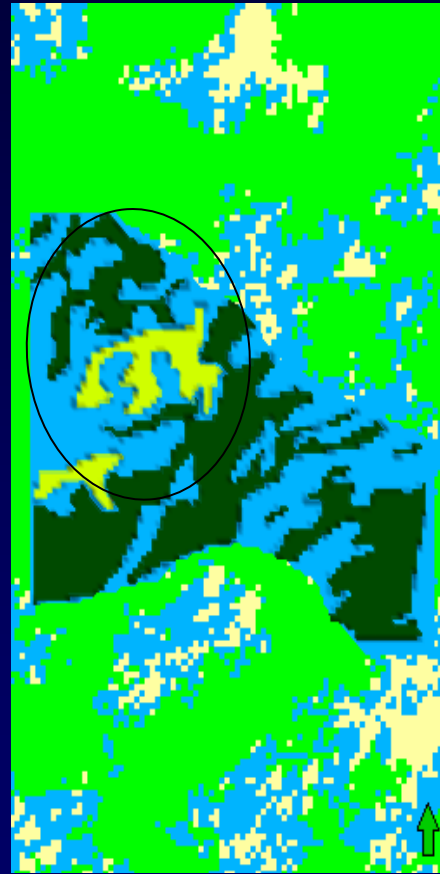


Modeled

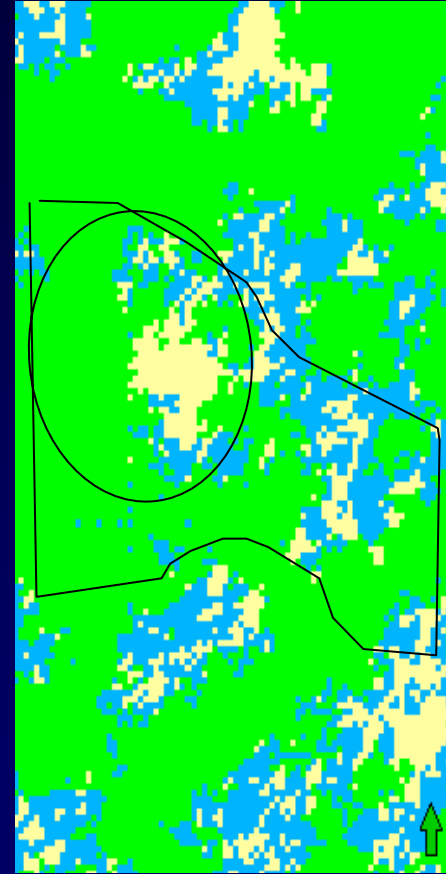


Multi-Step Model

Template



Modeled



 Collapsed  Disturbed  Undisturbed

Facies in 30-40 Ft Interval

Single-Step Model

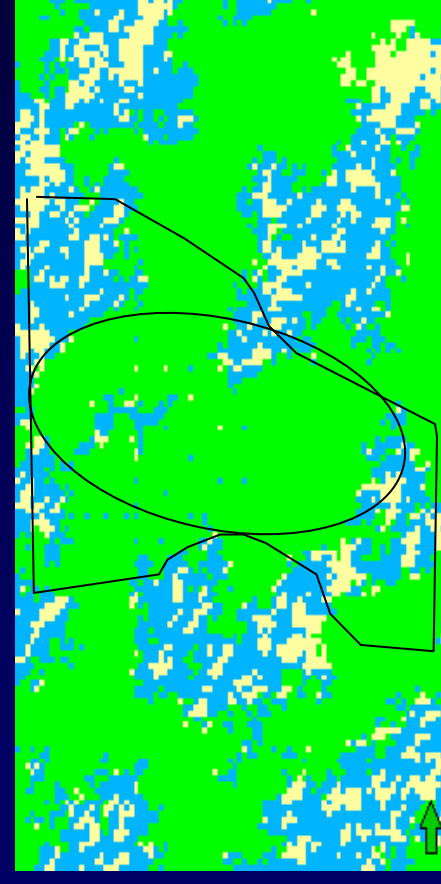
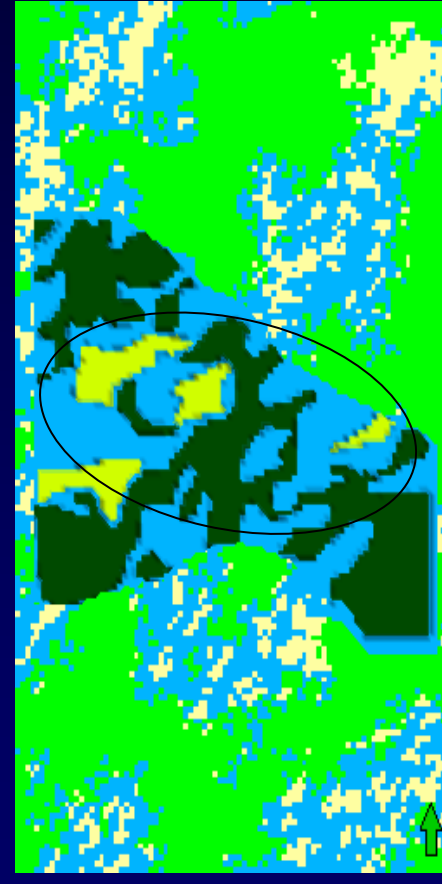
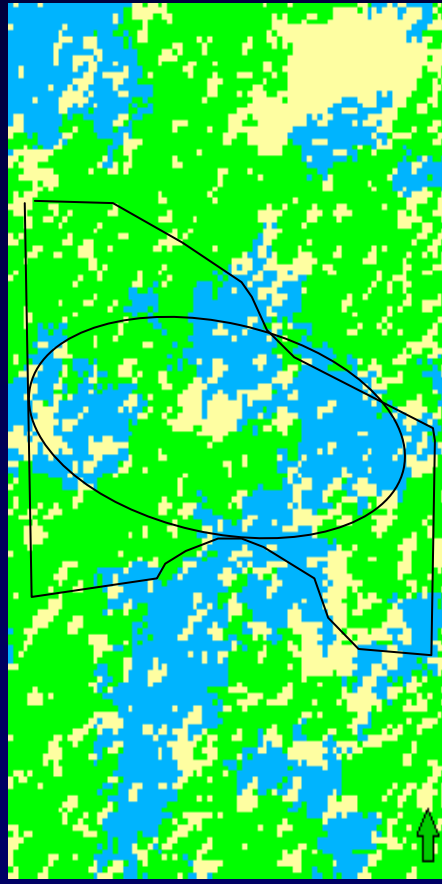
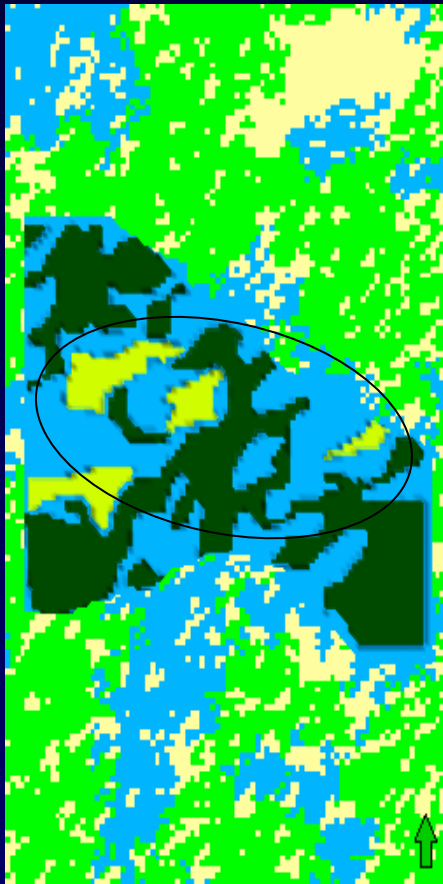
Multi-Step Model

Template

Modeled

Template

Modeled



Collapsed Disturbed Undisturbed

Summary

- Megасcale paleocave collapse features were mapped using outcrop, core and GPR data
- Paleocave facies include collapsed (brecciated), disturbed (fractured), and undisturbed rocks
- Paleocave facies are patchy and can be modeled by stochastic simulation
- Paleocave reservoirs show strong heterogeneity