Web-based Outcrop Digital Analog Database (WODAD): Archiving Carbonate Platform Margins*

By
J.A.M. Kenter[1] and P.M. Harris[2]

Search and Discovery Article #40300 (2008)
Posted August 15, 2008

*Adapted from oral presentation at AAPG Annual Convention, Houston, Texas, April 9-12, 2006. See companion article, "WODAD - A Web-Based Outcrop Digital Analog Database of Carbonate Platform Margins, " Search and Discovery Article #40308 (2008).

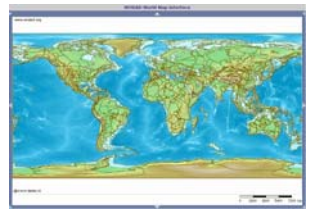
[1]Chevron Energy Technology Company, Amsterdam, Netherlands; currently Voorburg, Netherlands (jeroenkenter@chevron.com)
[2]Chevron Energy Technology Company, San Ramon, CA (MitchHarris@chevron.com)

Abstract

The lack of coherent and public data bases on outcrop data counterbalanced by the shared academic and industry need for such information has initiated the Web-Based Outcrop Digital Analog Database (WODAD). This public, searchable, database is a serious attempt to make outcrop information more readily available to earth scientists. Such analogs can help professionals to conceptualize stratigraphic, facies and diagenetic relationships that develop reservoirs and traps while it may provide academics with a tool to compare and contrast information across geological time and space.

WODAD will cover the Phanerozoic and include carbonates initially, but later clastics as well as mixed systems. The database consists of a series of chapters, each focusing on a specific outcrop. Each chapter contains a summary page with search items, a few (2-3) pages of descriptive information, and a short reference list. A section of each summary page contains the items that will eventually guide the search. The primary search items will be age, system type (for carbonate, platform type), rock properties (lithology, texture), overprint (recrystallization, fracture, karst), and geographical location.

The database will offer unique and unsurpassed opportunities for comparative research, many of which will be only discovered once the database is available. WODAD "carbonates" is currently operational thanks to start-up funding provided by Chevron. Outcrop contributions from academia and industry are invited through submission of an abstract as well as through personal invitations (see wodad.org for information and instructions). It is anticipated that by 2007 the database will be published as a digital publication.



Web-based Outcrop Digital Analog Database (WODAD): Archiving Carbonate Platform Margins

Jeroen AM Kenter and P Mitch Harris

Chevron Energy Technology Company, San Ramon, California, U.S.A

DOC ID AAPG_Hn_06_313

Rationale

Information on Outcrops

- ✓ Is generally poorly accessible; no systematic (semi) quantitative catalog exists in the public domain
- ✓ Is essential to the Earth Science community for contrast-comparative and background research
- ✓ Outcrops analogs are an important part of any hydrocarbon or water exploration or development project (conceptualize relationships that develop reservoirs and traps; limit and constrain uncertainties and need to standardization
- ✓ 53-56% booked reserves in carbonates and 25-35% of that depleted by 2009

However, matching analogs

- ✓ Are difficult to locate since no uniform catalog exists
- ✓ Often lack reliable, appropriate, coherent and “contrast-comparable” information (journals)
- ✓ Academics speak different geologic language than reservoir engineers and geologists

WODAD aims to provide

- ✓ A public “searchable” and “relational” digital outcrop analog database (web-based - downloadable)
- ✓ Including a set of key qualitative and quantitative variables that allow cross-variable queries
- ✓ Covering the Phanerozoic
- ✓ Including carbonates, clastics and mixed systems
- ✓ A database compatible with C&C Reservoirs Digital Analog System
- ✓ Published as digital AAPG publication where the contributors are co-authors

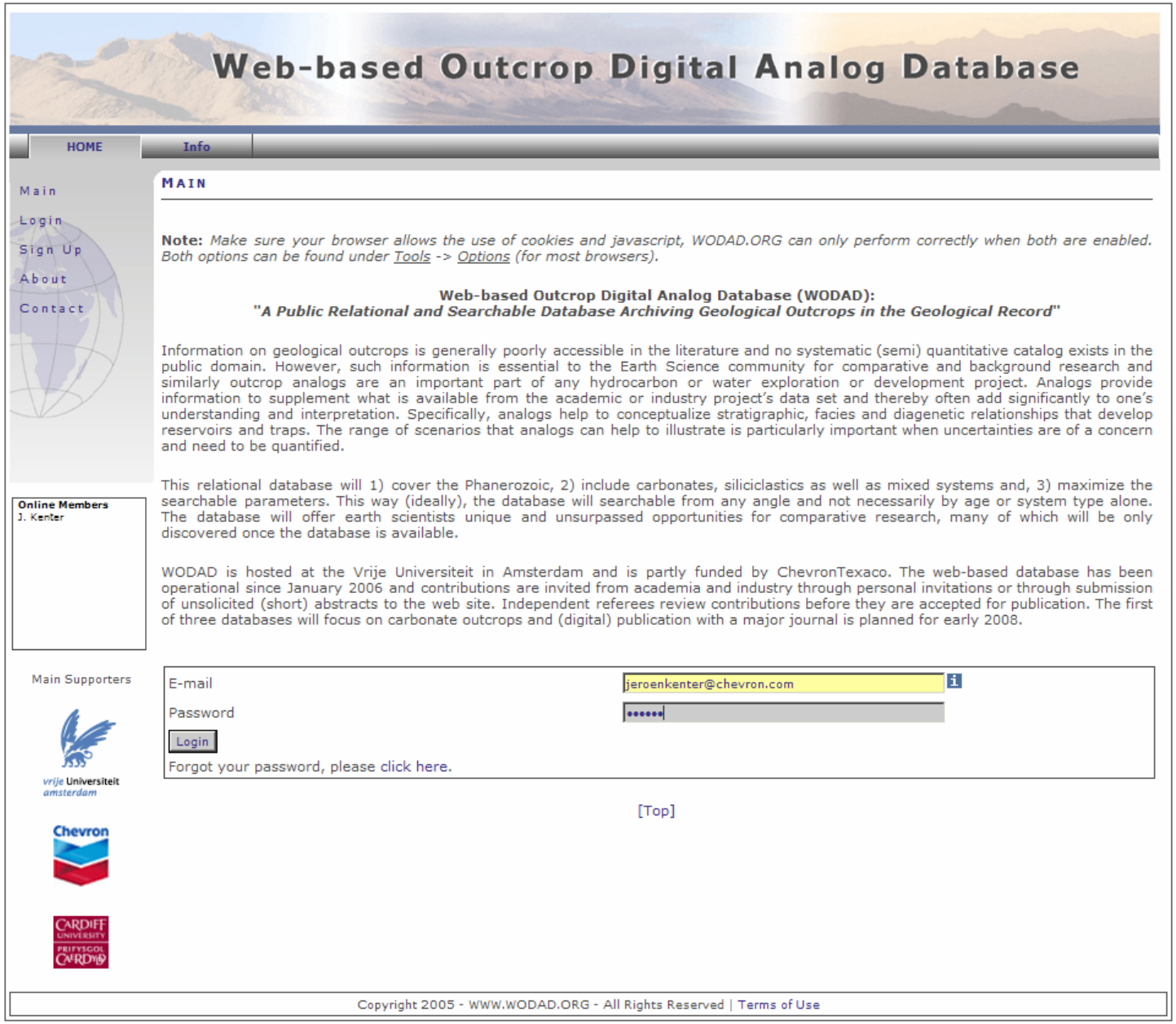
WODAD:

- ✓ Will function as a dynamic web-based database
- ✓ Is based on a combination of PHP and PostgreSQL; open source licensed packages keeps the database at a relative low cost level
- ✓ Is hosted with public university that has latest facilities and back-up systems
- ✓ PHP (Hypertext Preproccer) is server-side web-scripting language and connecting Web sites to back end servers (two-way communication), such as databases. This enables the following types of two-way communication
- ✓ PostgreSQL is an Object Relational Database which excels at handling large media objects, tables, spatial, and series style data sets

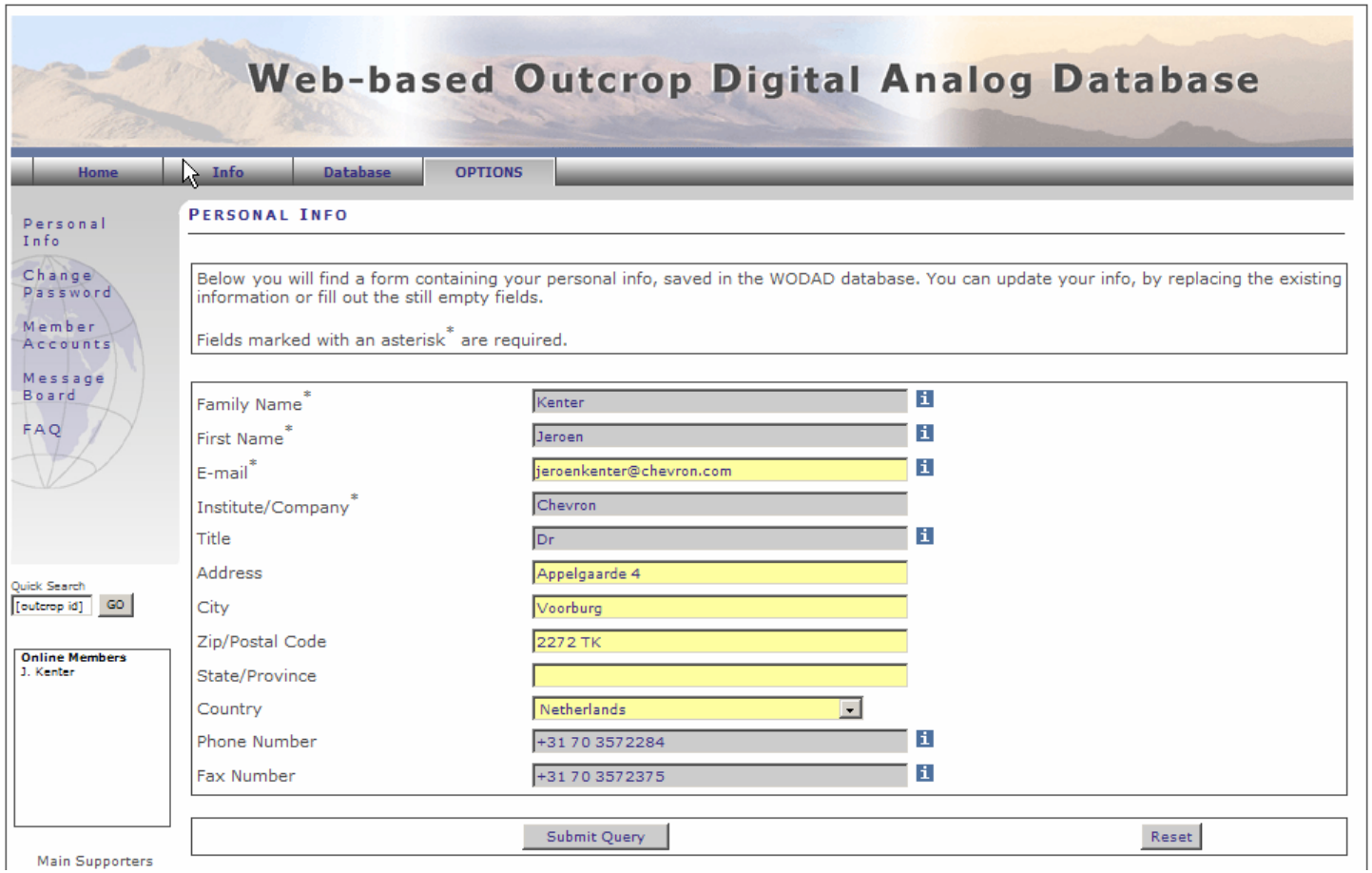
WODAD Properties:

- ✓ Fully searchable data base (functionality in progress)
- ✓ Open call for participants as well as invited contributions
- ✓ Pre-formatted pull down menus to ensure coherent information
- ✓ Simple primary search items like age, system type, rock properties, overprint, and geographical location; Information items short descriptions
- ✓ GIS based using Basin World Map
- ✓ Digital and analog data can be added as new items

Publicly visible WODAD



Registration WODAD



Active Contributors WODAD

WODAD CONTRIBUTORS

Administrator(s)

X. van Lanen	Vrije Universiteit Amsterdam

Principal Editor(s)

G. Della Porta	Cardiff University
M. Harris	Chevron Energy Technology Company
J. Kenter	Chevron

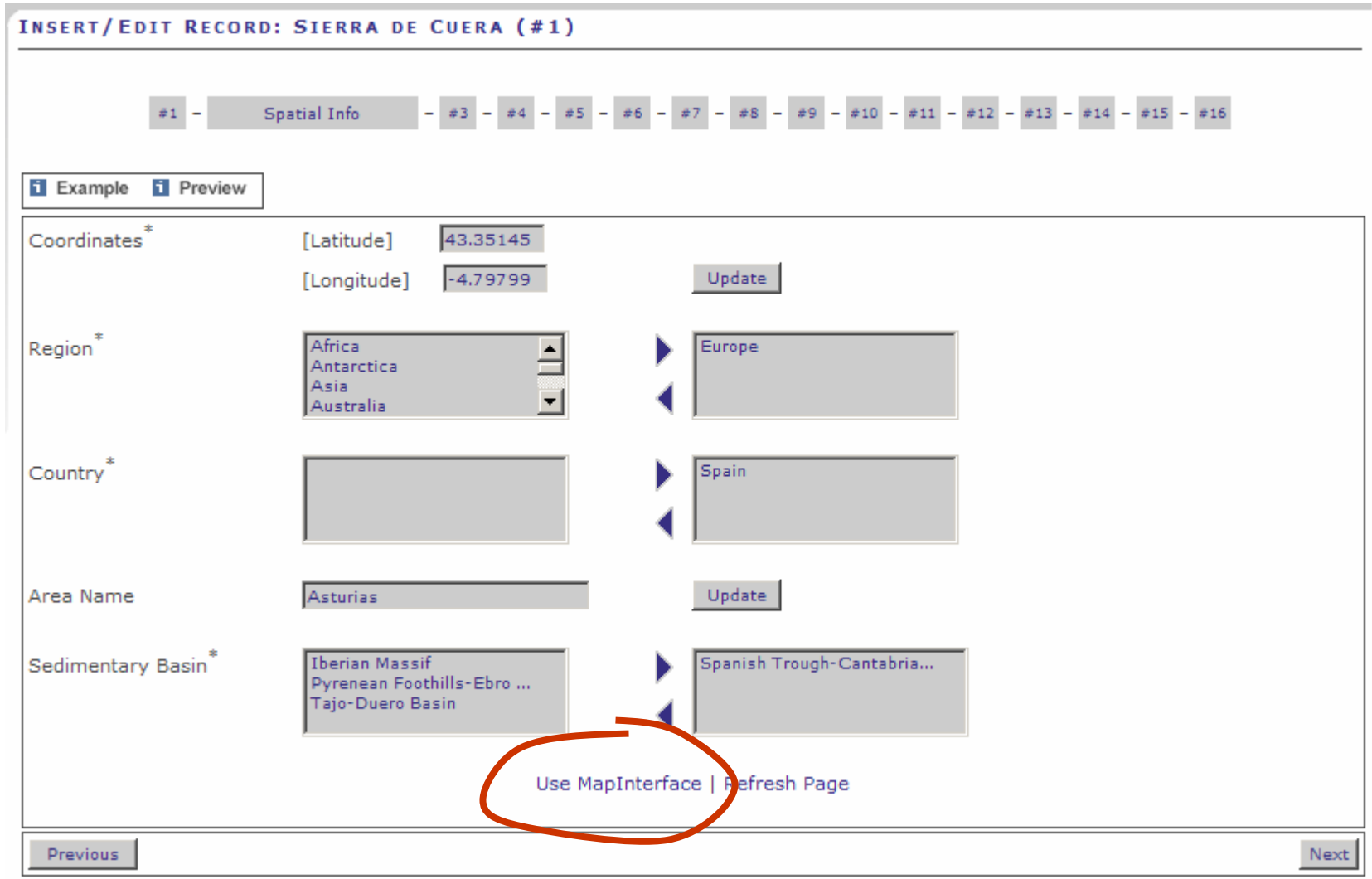
Editor(s)

No Editors

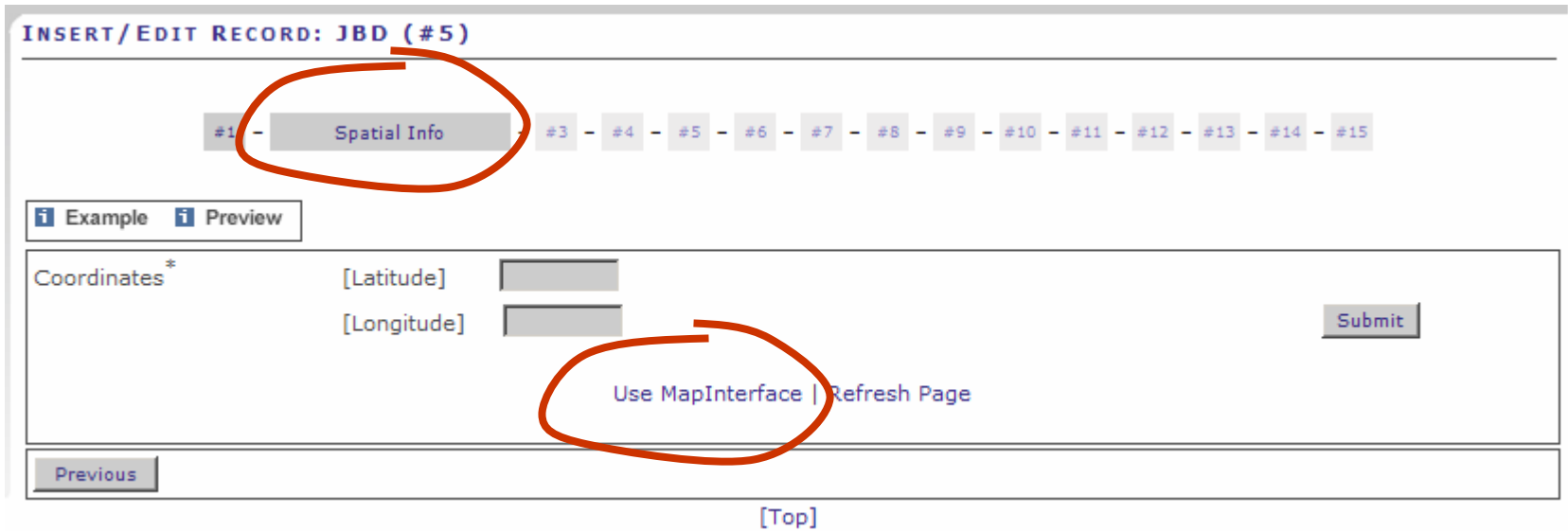
Contributor(s)

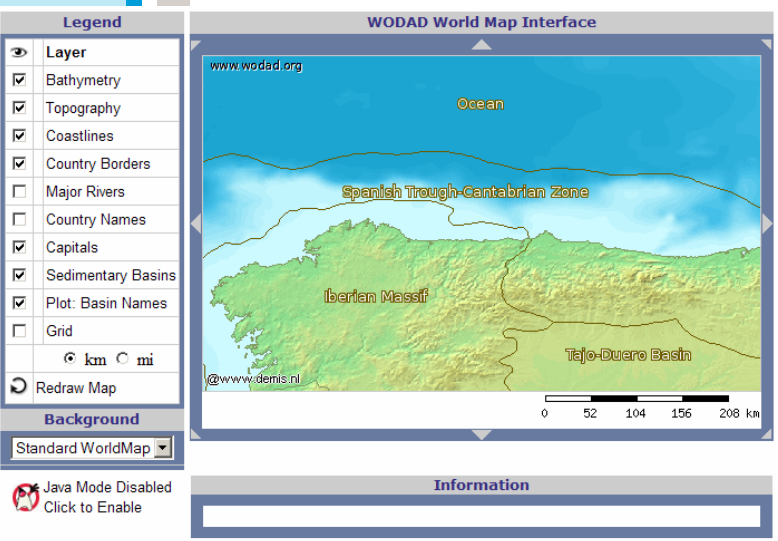
E. Adams	Shell International Exploration & Production B.V.
P. Bassant	Chevron
C. Kerans	BEG
T. Playton	BEG
L. Pomar	please replace for institute name
T. Simo	University of
K. Verwer	Vrije Universiteit
J. Xavier	BEG

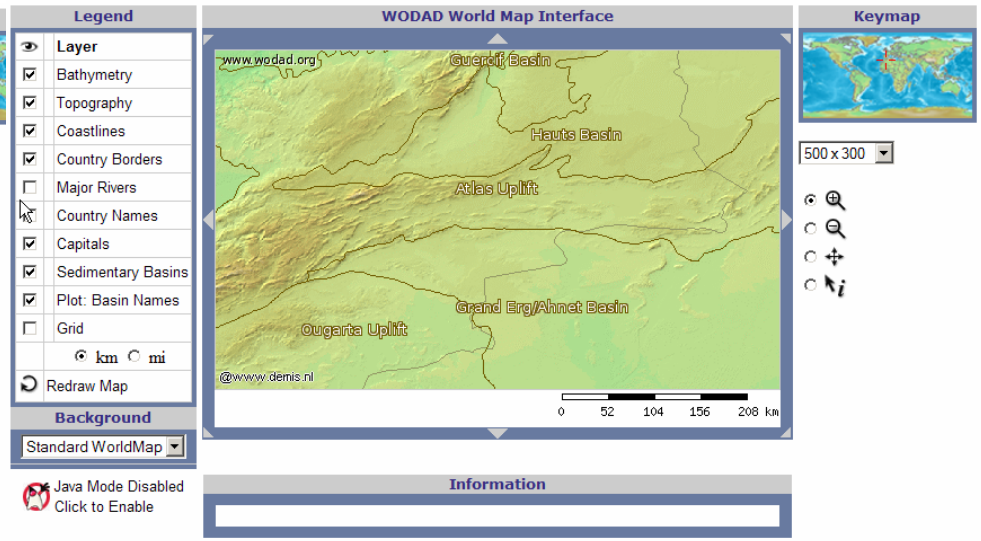
Data Submission – Simple Steps with Pull Down Menus



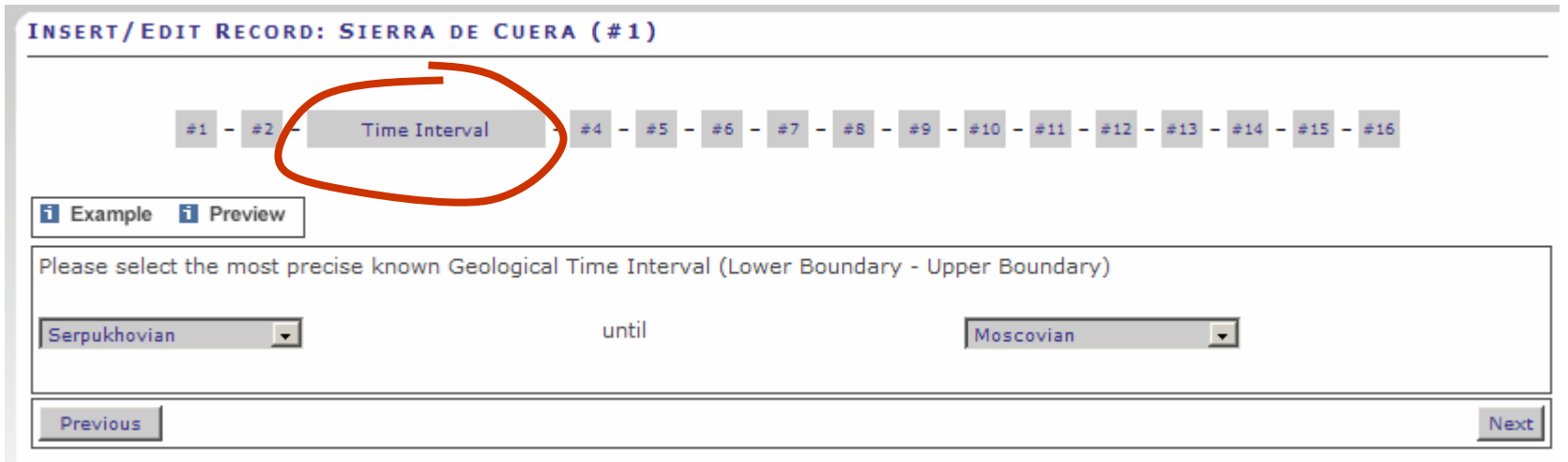
Spatial Information



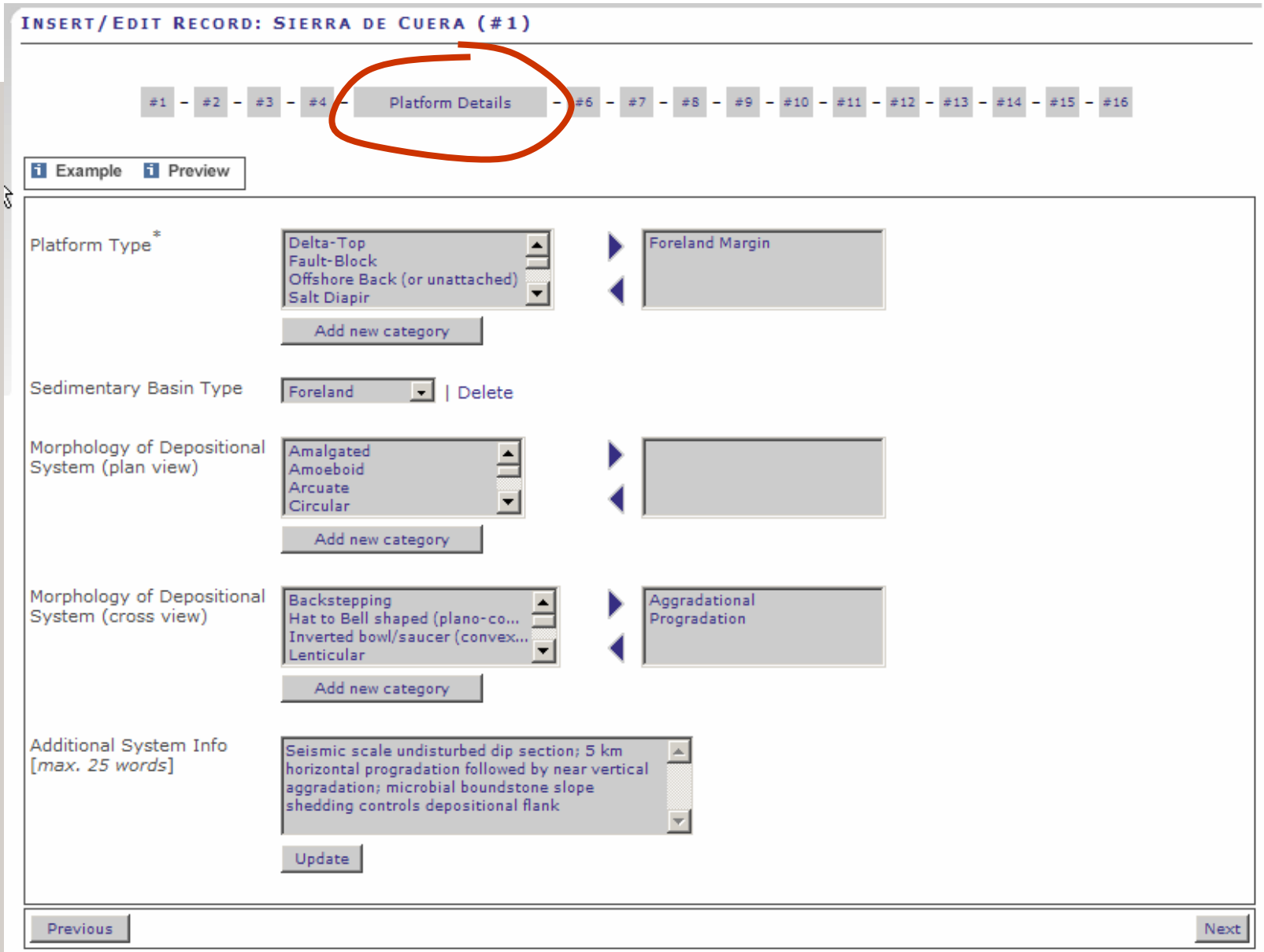




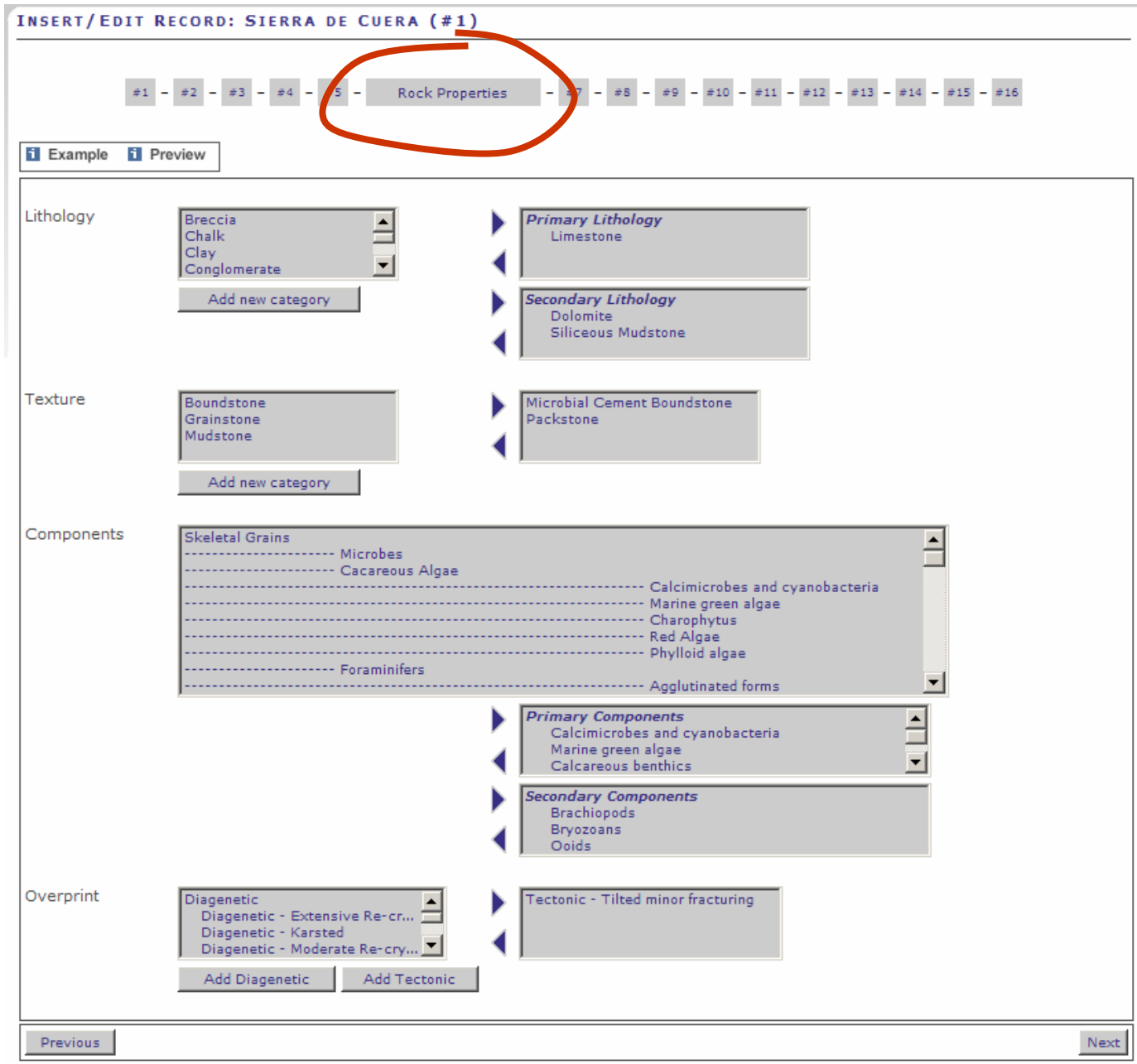
Time Interval



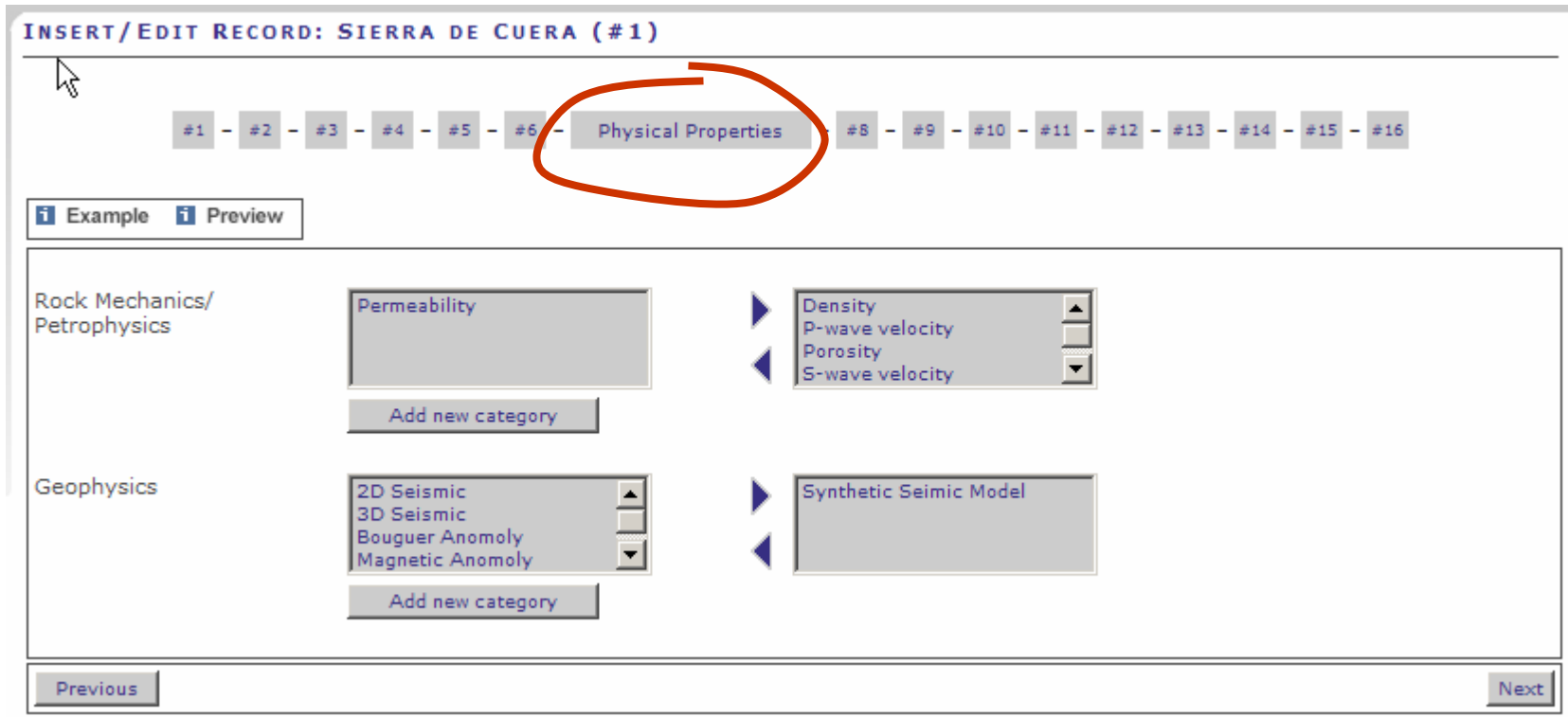
Platform Details



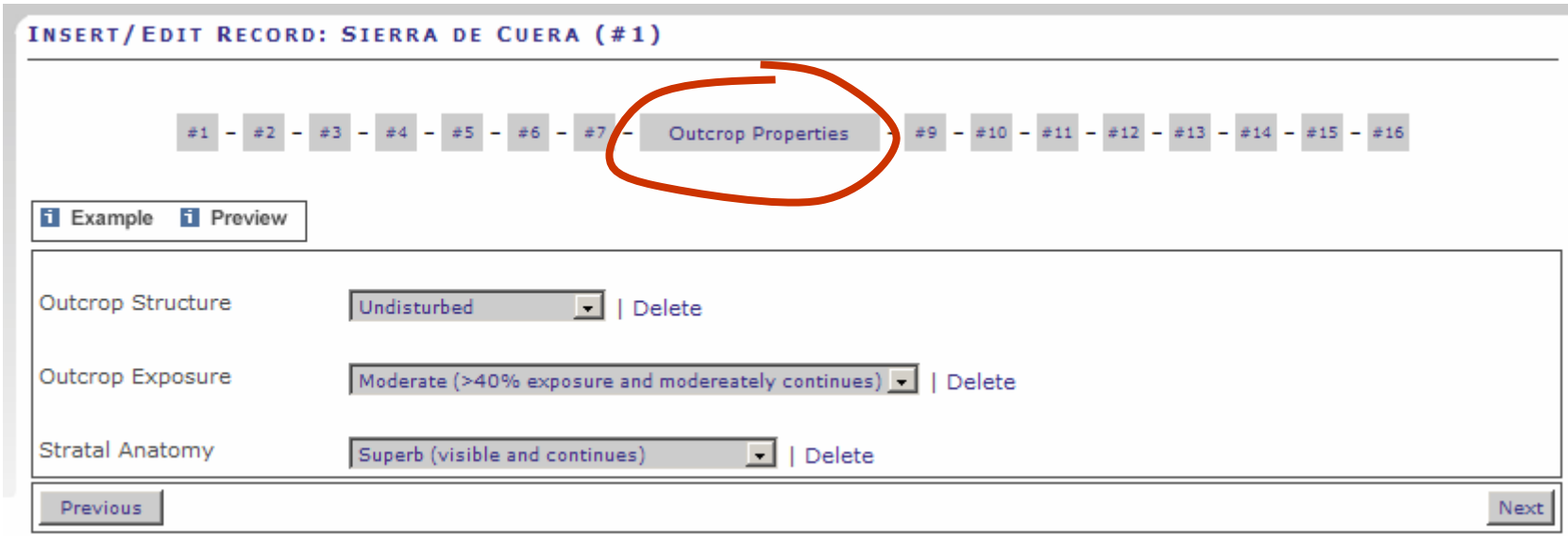
Rock Properties



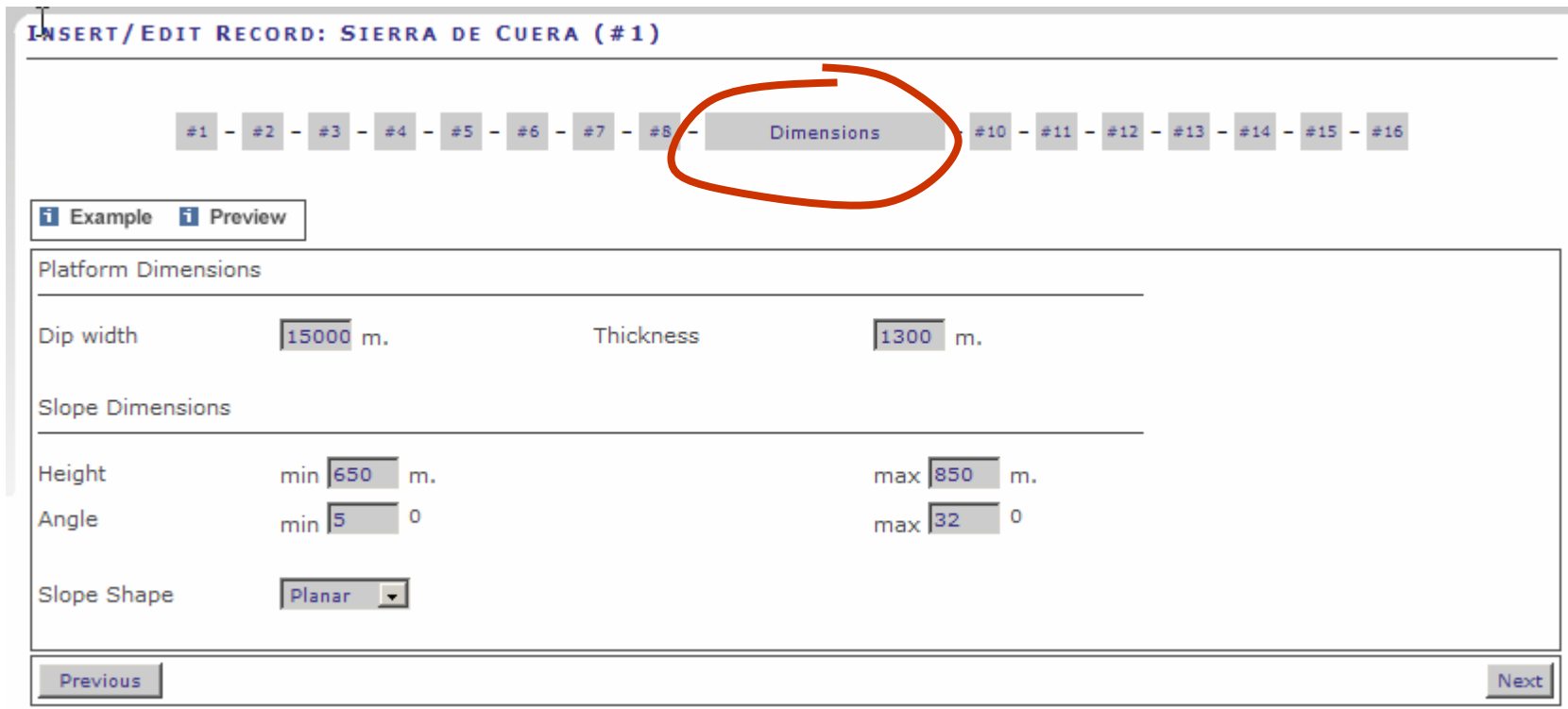
Physical Properties



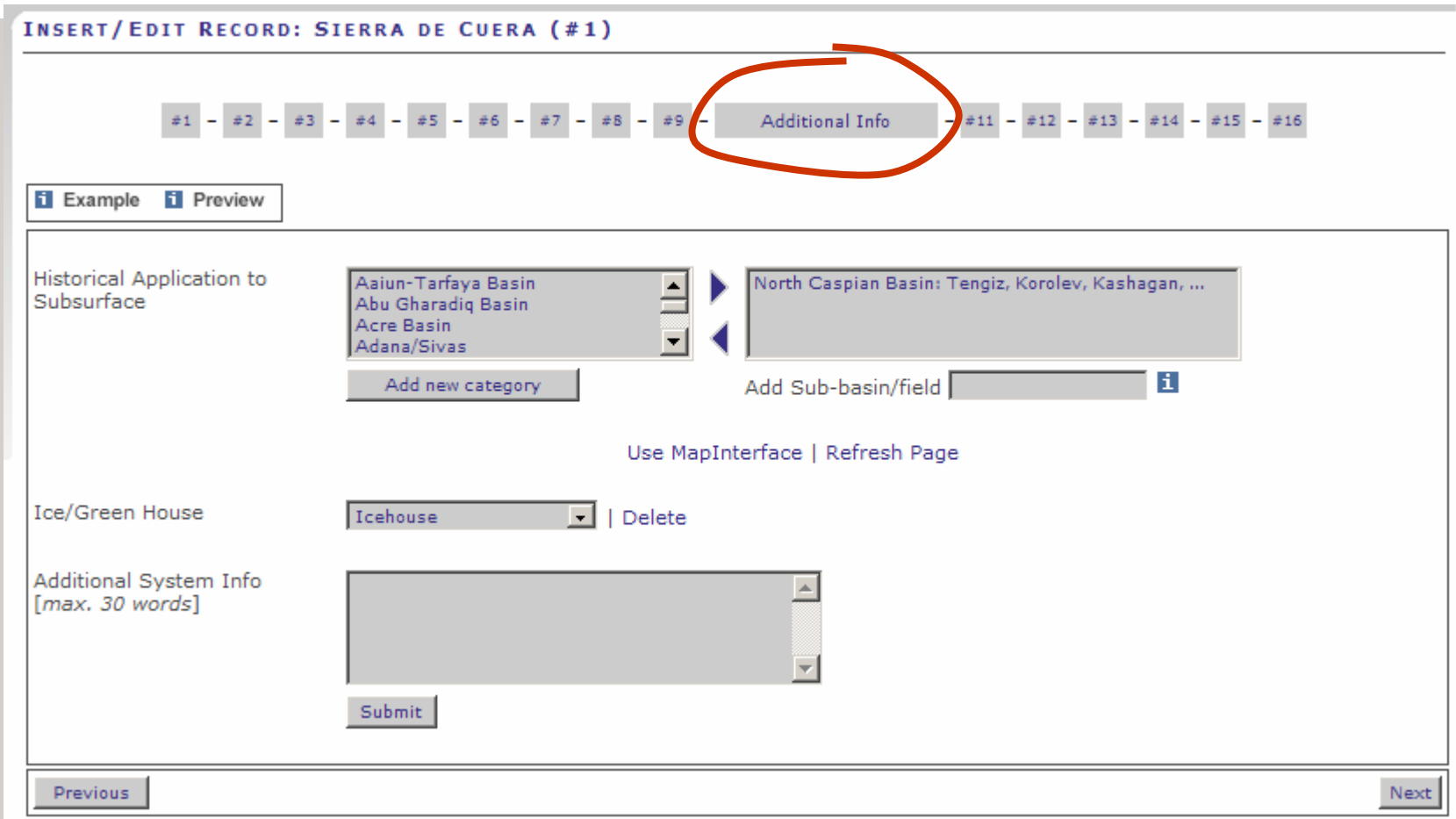
Outcrop Properties



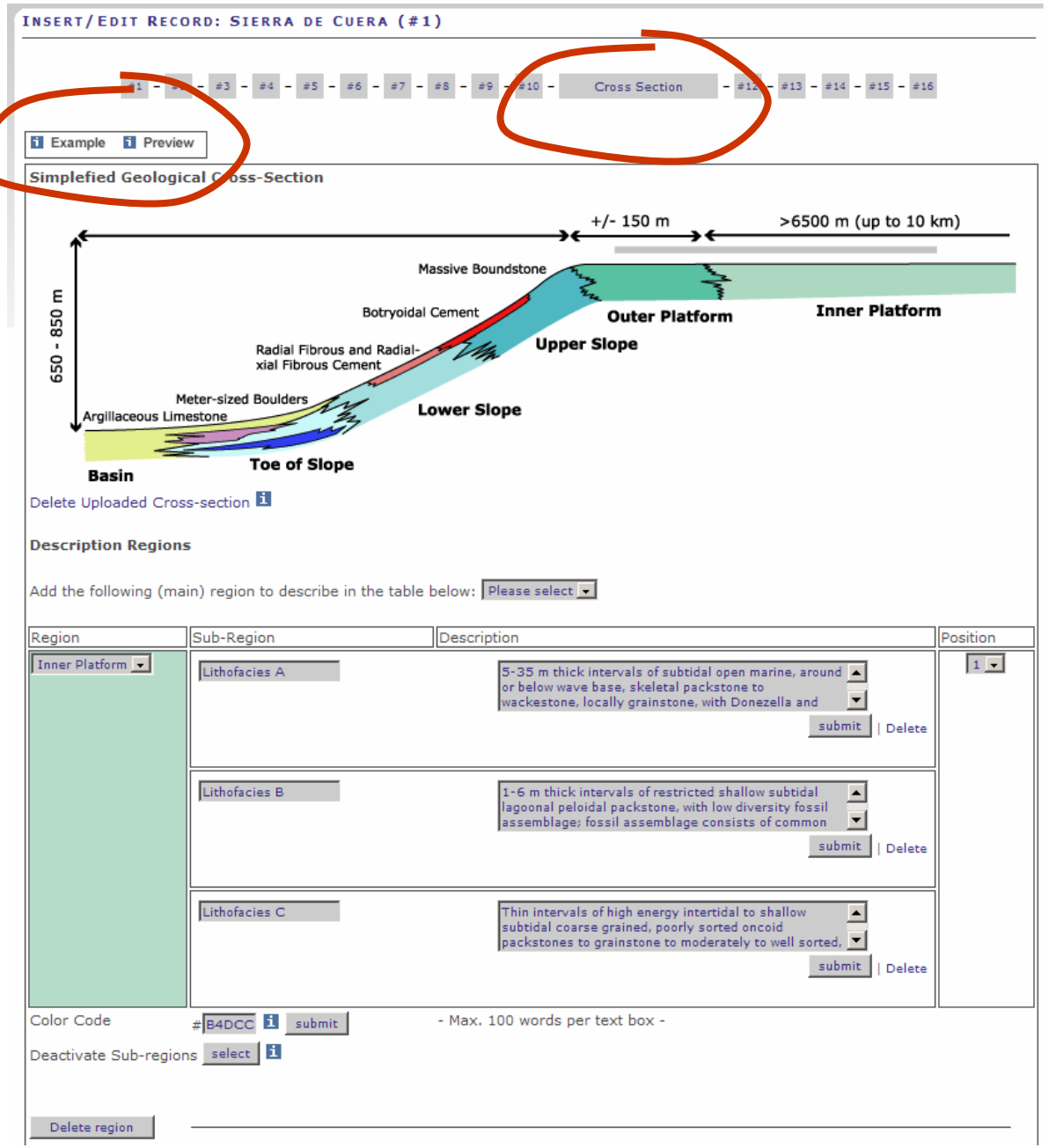
Object Dimensions



Additional Information



Example of Input Data Set



Example Depositional Information

INSERT/EDIT RECORD: SIERRA DE CUERA (#1)

#1 - #2 - #3 - #4 - #5 - #6 - #7 - #8 - #9 - #10 - #11 - #12 - #13 - Depositional - #15 - #16

Example Preview

Depositional

Five general lithofacies zones were observed: inner – and outer platform, upper slope, lower slope and toe-of-slope to basin (Kenter et al., 2002; Della Porta et al., 2002). 1) The platform deposits consist of subtidal limestones and contain shoaling-upwards cycles with a transgressive interval of coated grainstones with oncoids, followed by normal marine algal boundstone and bioclastic grainstone to packstone and, near the top, restricted lagoonal peloidal packstone to grainstone with calcispheres. These cycles have a thickness between 2.5 and 15 m and can be traced from the platform break into the platform interior for at least 6 km. The base consists of intraclast and coated grain-rich packstones and grainstones. Increase in water depth enhances the development of massive, carbonate mud-rich accumulations in a fine-grained packstone with in situ Donezella and scattered phylloid algae. This lithofacies (up to 20 m thick) shows a flat-lens shape, and is adjacent to locally bioturbated, skeletal packstone with a diverse, open marine fossil assemblage. These low-relief bioherms, besides Donezella and phylloid algae, contain bryozoans, ostracodes, encrusting benthic foraminifers, endothyrids, globivalvuliinids, paleotextularids, rare fusulinids, brachiopods, echinoderms, polychaete worm tubes, and rare sponge spicules and trilobites. At the top of the lense shaped bodies Chaetetes colonies and rare solitary rugose corals are observed. The associated skeletal packstone are enriched in benthic foraminifers and echinoderms. The fossil assemblage also includes brachiopods, bivalves, bryozoans and calcareous algae, and minor phylloid alga plates. The low relief algal bioherms are overlain by shallow

Submit depositional

Optional Figure(s)

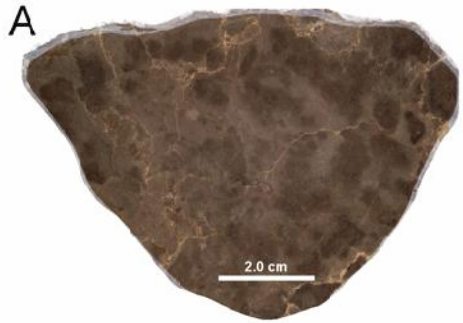
Figure

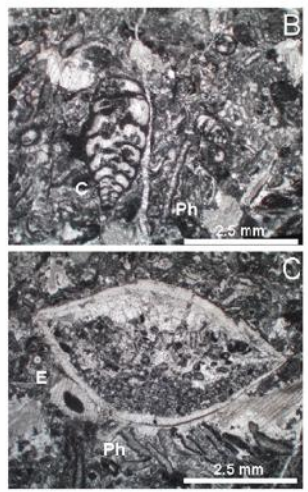
Browse...

[jpg, jpeg, gif and png formats, max. 500kb]

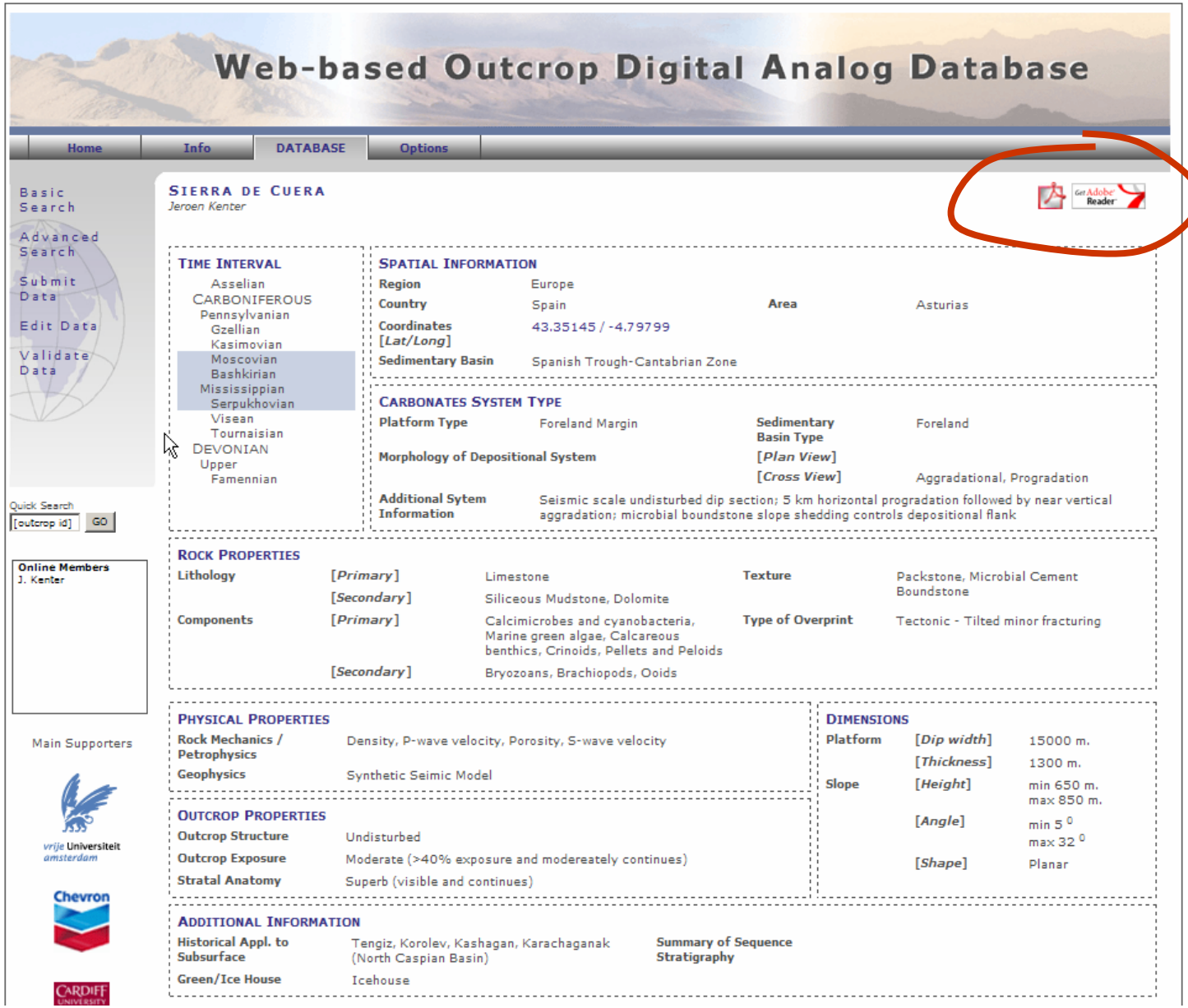
Caption [max. 500 words]

Upload figure and caption





PFD Reporting



PFD Report Sierra de Cuera - 1

SIERRA DE CUERA
J. Kenter

TIME INTERVAL

Asselian
Carboniferous
Pennsylvanian
Gzellian
Kasimovian

Moscovian
Bashkirian
Mississippian
Serpukhovian

Visean
Tournaisian
Devonian
Upper
Famennian

SPATIAL INFORMATION

Region Europe
Country Spain **Area** Asturias
Coordinates [*Lat/Long*] 43.35145 / -4.79799
Sedimentary Basin Spanish Trough-Cantabrian Zone

CARBONATES SYSTEM TYPE

Platform Type Foreland Margin **Sedimentary Basin Type** Foreland

Morphology of Depositional System
[*Plan View*]
[*Cross View*] Aggradational, Progradation

Additional System Information
Seismic scale undisturbed dip section; 5 km horizontal progradation followed by near vertical aggradation; microbial boundstone slope shedding controls depositional flank

ROCK PROPERTIES

Lithology	[*Primary*]	Limestone	**Texture**	Packstone, Microbial Cement Boundstone
	[*Secondary*]	Siliceous Mudstone, Dolomite		
Components	[*Primary*]	Calcimicrobes and cyanobacteria, Marine green algae, Calcareous benthics, Crinoids, Pellets and Peloids	**Type of Overprint**	Tectonic - Tilted minor fracturing
	[*Secondary*]	Bryozoans, Brachiopods, Ooids		

PHYSICAL PROPERTIES

Rock Mechanics / Petrophysics	Density, P-wave velocity, Porosity, S-wave velocity
Geophysics	Synthetic Seimic Model

OUTCROP PROPERTIES

Outcrop Structure	Undisturbed
Outcrop Exposure	Good (>60% exposure and moderately continues)
Stratal Anatomy	Superb (visible and continues)

DIMENSIONS

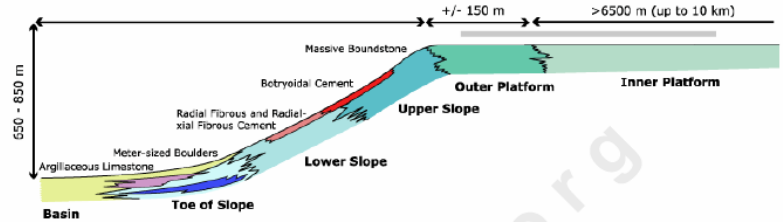
Platform	[*Dip width*]	15000 m.
	[*Thickness*]	1300 m.
Slope	[*Height*]	min 650 m. max 850 m.
	[*Angle*]	min 5 ° max 32 °
	[*Shape*]	Planar

ADDITIONAL INFORMATION

Historical Appl. to Subsurface	Tengiz, Korolev, Kashagan, Karachaganak (North Caspian Basin)	**Summary of Sequence Stratigraphy**	
Green/Ice House	Icehouse		

PFD Report Sierra de Cuera - 2

GEOLOGICAL CROSS SECTION WITH DESCRIPTION OF THE MAJOR REGIONS

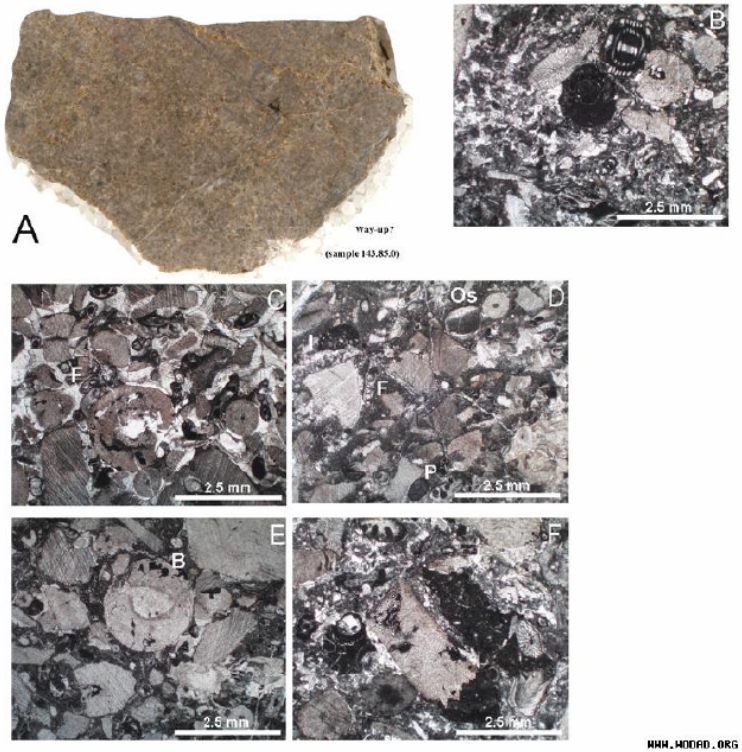


Region / Sub-Region	Description

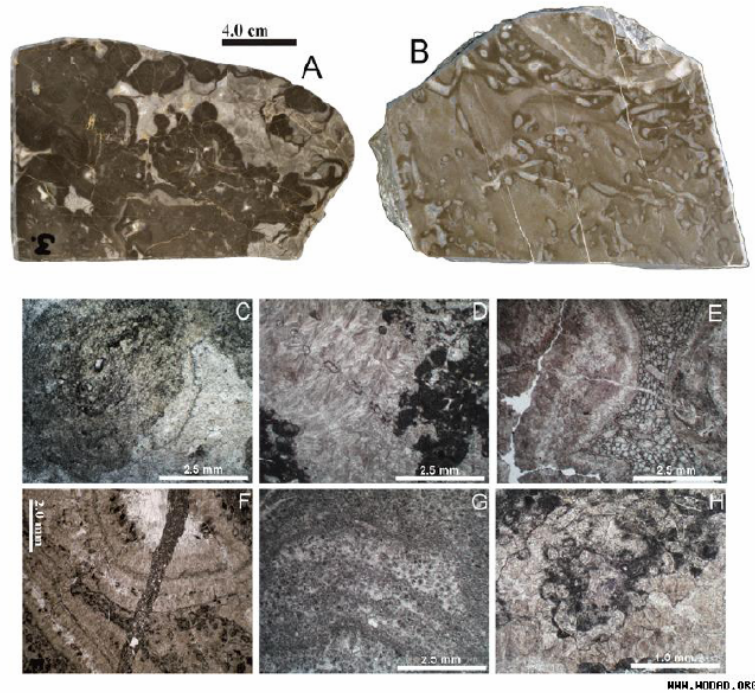
Inner Platform	Lithofacies A	5-35 m thick intervals of subtidal open marine, around or below wave base, skeletal packstone to wackestone, locally grainstone, with Donezella and phylloid algae along with diverse skeletal grains and probabl;y formed mounds in A1. The skeletal assemblage consists of: foraminifers (fusulinids, Endothyra, Globivalvulina, tubular calcitornellids, Climacammina, Bradyina, Tuberitina, Tetrataxis), calcareous algae (few phylloid algae, Komia and Ungdarella, very rare beresellid algae and Donezella fragments), echinoderms, and rare bryozoan fragments, ostracodes, brachiopods, and bivalves. Few peloids and rare oncoids and intraclasts are observed. Lithofacies A represents the m-scale alternation of flat lens-shaped algal-skeletal banks (A2) and bioclastic debris sediments (A1) deposited in an open marine, subtidal environment.
	Lithofacies B	1-6 m thick intervals of restricted shallow subtidal lagoonal peloidal packstone, with low diversity fossil assemblage; fossil assemblage consists of common to few calcareous algae (Beresella, Dvinella, Uraloporella, Petschoria, Ungdarella, Komia, phylloid algae), few foraminifers (fusulinids, endothyrids, Climacammina, Bradyina, Tetrataxis, Tuberitina, Globivalvulina), calcispheres, ostracodes, brachiopods, echinoderms. In situ Chaetetes colonies and fragments. Few to common peloids; coarser intervals with rare oncoids, intraclasts, fusulinids and echinoderms. Burrows (mm's to cm's size). Locally Microcodium and common peloids.The texture and paleoecology of the fossil assemblage contained in lithofacies B are indicative of a shallow lagoon, with deposition in normal marine (B1) to restricted conditions (B2).
	Lithofacies C	Thin intervals of high energy intertidal to shallow subtidal coarse grained, poorly sorted oncoid packstones to grainstone to moderately to well sorted, mixed coated grain-skeletal-intraclast-ooid grainstone. C1 is represented by bedded intervals, frequently thin, rich in oncoids and associated with lithofacies B; C2 is ooid coated pisoid grain grainstone and coated grain-skeletal-peloid grainstone/packstone associated with lithofacies D. These intervals are generally not compacted and have abundant cement. Near the platform break, the C2 interval does not contain oncoids and it is a well-washed ooidal grainstone with isopachous rims of fibrous cement. In the outer platform are grainstone intervals, nearly 5 m to 2 m thick, which should be considered separately. Components are benthic foraminifers (Bradyina, fusulinids, tubular calcitornellids, Climacammina, endothyrids, staffellids), few calcareous algae (Epimastopora, Komia, Beresella, phylloid algae), few to common crinoids and echinoid spines, rare brachiopods, fenestellids, gastropods, and fragments of Chaetetes. Rare observed presence of Microcodium but common to few Osagia oncoids, coated grains, ooids, aggregates, peloids, and intraclasts. Evidence found for current and wave traction; cross-bedding (?) and subaerial exposure.

PFD Report Sierra de Cuera - 3

Caption: Figure 6 cont'd (K) Coated grain-oncoid packstone of lithofacies C1 showing an intraclast with micritic coating, fusulinid fragments, echinoderms, and phylloid algae (Ph). (L) Fragments of probable Microcodium in lithofacies C1. (M) Komia (K) and fenestellid bryozoans (F) in clotted peloidal micrite. (N) Boundstone type of lithofacies D with the alga defined as Iberiaella (Ib) by Rácz (1984) associated with dark homogenous and clotted micrite; the algal branches create shelter cavities filled by radial fibrous cement. (O) The alga Iberiaella exhibiting encrusting habit associated with automicrite and tubular calcitornellid foraminifers. (P) Sub-spherical and elongated biomolds in lithofacies D, which could represent either phylloid algae or sponges. (Q) Lithofacies D microfacies type rich in homogenous carbonate mud and fenestellid bryozoans. (R) Lithofacies D with bryozoans and abundant cement filling primary cavities. (S) Lithofacies D boundstone with clotted peloidal micrite containing fractures filled by dark yellow/brown cement of probable meteoric origin (?) (T) Photomicrographs showing ooids, coated grains and intraclasts filling pockets and fissures within lithofacies D boundstone; grains were likely reworked and transported by currents and waves. (U) Slab photo showing the top of lithofacies D unit in section 0 at 29.8 m is characterized by a brecciated and altered horizon suggested to be the result of subaerial exposure.



Caption: Figure 7. Lithofacies Type E - Platform Flooding and Outermost Platform (A) Slab photo showing typical lithofacies E. (B) Lithofacies E-A1 skeletal packstone containing crinoid ossicles, peloids, staffellids, Bradyina, ungdarellid algae and bryozoan fragments. (C) Crinoid dominated grainstone to rudstone with syntaxial overgorwth calcite cement and associated fenestellid bryozoa. (D) Packstone containing echinoderms, fenestellid bryozoan fragments (F), intraclasts (I) pellets (P) and an ostracod shell (O). Lithofacies Type E - Platform Flooding and Outermost Platform (E) Crinoid-dominated pack- to rudstone showing crinoid ossicles with borings and sediment fills. (F) Skeletal packstone with crinoid ossicles, Komia, brachiopod fragments and intraclasts.



Funding and Support

- ✓ **Funding has been committed by VUA group, revenues Chevron (2 years) and negotiations are continuing with other industry partners**
- ✓ **Technical support is provided by Chevron**
- ✓ **AAPG is very positive and willing to publish the Carbonate Volume**

Conclusions

WODAD will provide a searchable and interactive database facilitating

- ✓ **Conceptualization of stratigraphic, facies and diagenetic relationships**
- ✓ **Providing quantitative information that can be compared across timescales and worldwide**
- ✓ **15 data sets are currently edited as test phase**
- ✓ **Search functionality is currently added**
- ✓ **An Open Call will be advertised and individual authors will be contacted**
- ✓ **Spatial (GIS) data sets will be added soon**