Microfossil Project: Specialized area of radiolarians and conodonts; Marble dissolution procedure sheet; Microfossil sample sites 2007 (map).
Oregon Caves National Monument
Emory Nelkie

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Microfossil Project

Specialized area of radiolarians and conodonts
Oregon Caves National Monument

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Abstract

Conodont and radiolarian microfossils are a crucial part of age dating and rock correlation in the Klamath region of the Pacific Northwest. Their importance prompted a search for their presence in the varying lithologies that compose Oregon Caves National Monument. Fifteen samples of varying rock types from chert, marble, and argillite were collected and digested for microfossils. All samples were found to be barren of microfossils. It can be concluded on this basis that the rocks composing the monument have been metamorphosed to the point that no identifiable microfossils remain.

Introduction

Microfossils are commonly found through the Cenozoic and Mesozoic and are used for biostratigraphy, paleoenvironment analysis, and age dating. Conodonts in the Triassic Period and radiolarians in the Mesozoic and Cenozoic Eras are found in the sedimentary and metamorphic rocks, including limestone, shale, chert, and marble. The rocks of Oregon Caves National Monument are conjectured to be from the Triassic Period of the Early Mesozoic Era and are primarily metamorphic rocks including marble chert, and argillite. The chemical makeup of conodonts and radiolarians, apatite and silica respectively, allows for their easily extraction from these metamorphic rocks.

Methods

The search for conodonts and radiolarians commenced with the collection of fifteen samples from the marble block of Oregon Caves National Monument and the surrounding rock (pg 11). The rock types collected included eight marble samples, two chert samples, and five argillite samples. Each of the samples was scrubbed clean of outside organic material, crushed, and put through a chemical digestion process to break down the rock and extract the microfossils (pg 7, 8). The residues created from the digestion were then sifted under a 10X binocular dissecting microscope for conodont elements. The residues were then wet sifted under a 4 X, 10 X, 40 X, and 100 X binocular biological microscope for radiolarians.

Results

The fifteen samples collected yielded no microfossils that could be distinguished from the rest of the crystal mass. The minerals that could be identified are outlined for each sample (pg 9, 10). Other minerals also may be present but are not identified.

Discussion

The lack of microfossils and the presence of certain metamorphic minerals such as garnet, and partially-to-totally recrystallized quartz, and the large size of the crystal, 0.5mm to 1mm, indicated that the marble block and the surrounding area was heated and pressurized to the point that apatite and silica began to recrystallize, altering the structure of the grains and destroying evidence of microfossil presence in the rocks. The heat and pressure that caused was likely from the volcanic activities in the area and not due to the initial deformation of the marble block.

Based on the existence of two conodont species, *Epigondolella Bidenta, and Epigondolella Abneptis*, recovered from marble and chert to the south and west of the monument (Irwin B.R, 1983), the age for the marble block is somewhere between ~228 M.A. and ~203 M.A. These species ranged from the Julian to early Sevatian regional stages, and early Karnian through the middle Norian stage of the Middle and Late Upper Triassic.

Future work

The metamorphic grade of the marble block in which the cave resides is too high for the presence of radiolarian or conodont microfossils to be preserved. To find conodont and radiolarian microfossils within or adjacent to the monument it is recommended that there be a one quarter to one half mile buffer between sample localities and any volcanic activity, including any small intrusions. Sample preparation, with reasonable expectation of success, would then follow the procedures outlined in this paper.

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Samples	Initial sample weight (g)	Weight of sifted sample (g)	Discarded material (g)	Rock type	Location (on map)
Sample 1A	1381.9	158	1223.9	CC	1
Sample 1B	161.3	2.9	158.4	C	1
Sample 2A	1295.8	36.8	1259	CC	2
Sample 3A	1316.8	190.3	1126.5	CC	3
Sample 4A	1209.6	344.8	864.8	A	4
Sample 5A	874.4	41.3	833.1	CC	5
Sample 6A	1588.6	0.2	1588.4	C	6
Sample 7A	1323.4	0.1	1323.3	A	7
Sample 8A	1176.3	0.6	1175.7	CC	8
Sample 9A	974.3	3	971.3	CC	9
Sample 10A	987.9	39.6	948.3	CC	10
Sample 11A	1417.2	18.8	1398.4	C/CC	11
Sample 12A	1255.2	0.2	1255	A	12
Sample 13A	497.7	0.6	497.1	A	13
Sample 14A	1049.9	1.2	1048.7	A	14
Total weight	16510.3	838.4	15671.9		

CC= crystalline carbonate
C= chert
A= argillite / med sediment

The purpose of this document is to record rock type and sample weight.

Conodont and Radiolarian Sampling and Rock Breakdown Procedures

Samples

Samples were chosen on the bases of the degree of metamorphism that occurred in the rock. Choice samples are characterized by the following:

-more sedimentary than metamorphic in nature
-doesn't break through grains that are present
-loose-to-moderately cemented
-bedding or relic bedding

Products

Products used in digestion of rock types are as follows:

-Tetrasodium pyrophosphate
-Sulfuric acid 3M
-Nitric acid 3M
-Hydrogen Peroxide
-Sodium Hydroxide ACS grade
-Acetic Acid 4.5% acidity
-weak alcohol
-Muriatic acid 31.45% HCl

Procedures

Initial, less stringent marble breakdown method one

Break ~500 to 1000 grams of sample rock into 0.5 - 0.75 inch chunks and submerge in a 4% - 10% concentration solution of acetic acid, stir twice a day, and change out acid every 2 days. Rinse the resulting residue with water and sieve the result through 10, 35, and 325 mesh screens and collect the residue from the 325 screen.

Secondary, stringent marble breakdown method two

Take the remaining sample from the 10 and 35 mesh screens from method one if any is left and submerge in a concentrated HCl solution, in a hood. Boil for 15 - 20 min adding HCl as it is used up. Allow sample to cool and residue to settle, then decant. After boiling, wash in distilled water. Sieve the resulting through the, 35, and 325 mesh screens and collect the product from the 325 screen.

Initial, less stringent breakdown of sedimentary deposits method one

Break into 0.75 - 1 inch chunks and submerge into a beaker of distilled water. Then add 3 to 4 grams of Teterasodium pyrophosphate for every 10 grams of sample. Allow to set for ~ 24 hours. If any un-dispersed clay remains add more reagent and set aside for another day. Rotate sample after it has dispersed. Allow sample to stand for 10 min and decant the water off, repeat until residue is clean. Then boil the sample for about 30 min in distilled water and 10% sulfuric acid until organics are removed. After organics are gone, wash sample in weak alcohol solution, sieve the result through the 35 and 325 mesh screens and collect the residue from the 325 screen.

Secondary, stringent breakdown of sedimentary deposits method two

Break into 0.75 - 1 inch chunks and submerge in concentrated HCl. Boil the mixture for 15 - 20 min and, without washing, add an equal volume of concentrated nitric acid. Boil the solution until the brown fumes disappear and wash sample thoroughly with water. Boil the sample in concentrated sulfuric acid until all organic matter is gone. After boiling, wash with water until all traces of the acid are gone, then add a few pellets of sodium hydroxide to the water. Boil wash sample again and boil in a few drops of HCL to neutralize the alkali. Sieve the sample through the 35 and 325 mesh screens and collect the residue from the 325 screen.

Purpose

The purpose of this document is to create guidelines by which the rock collections and digestion of rocks can be followed and duplicated. The digestion techniques originate from the *Treatise on Invertebrate Paleontology Volume D Protista* and *Treatis on Invertebrate Paleontology Volume W Miscellanea.*

Sample descriptions
After treatment with 31.45% hydrochloric acid to remove marble from sample

Sample 1a

Crystalline texture, particles 1.25mm or less, angular crystalline quartz ~70-75% of sample, graphite flakes ~5% or less of sample, gray mineral one good plane of cleavage not identified.

Sample 1b

Granular texture, particles 1.25mm or less, granular textured white-to-gray semi translucent quartz crystals 70% of sample, clumps of clay material present mineral composition not identified.

Sample 2a

Granular to crystalline texture, particles 1.5mm or less, well-rounded frosted white grains ~1.25mm 15 to 20% of sample, quartz crystals white-to-gray granular texture, graphite flakes ~ 5% of sample, mica crystals 5% or less of sample, white fibrous mineral not identified 40-50% of sample.

Sample 3a

Crystalline texture, particles 0.25mm or less, translucent white-to-gray quartz crystals, very fine mica and biotite crystals present. Traces of white fibrous mineral not identified.

Sample 4a

Crystalline texture, particles 1mm or less, biotite and mica 70-80% of sample, 0.75mm crystalline quartz and iron oxide pellets 20-30% of sample.

Sample 5a

Granular texture, particles 0.25mm or less, white-to-gray translucent quartz 10-20% of sample, white vitreous luster one good plane of cleavage (unknown mineral) 20-30% of sample, biotite muscovite and graphite 50-60% of sample.

Sample 6a

Crystalline texture, particles 1.25mm or less, clear-to-gray semi-translucent quartz 20% of sample, white vitreous luster one good plane of cleavage evident (unknown mineral) 40% of sample.

Sample 7a

Granular texture, particles 1mm or less, translucent quartz, white vitreous luster one good plane of cleavage evident (unknown mineral) 30-40% of sample, brown clumps of clay material not identified.

Sample 8a

Granular to crystalline texture, particles 1.25mm or less, clear-to-white translucent quartz 30-40% of sample, flaked graphite 20% of sample, mica and biotite 10-15% of sample.

Sample 9a

Granular-to-crystalline texture, particles 1mm or less predominantly less than 0.5mm through out sample, white to gray semi translucent granular textures quartz 30% of sample, less than 0.25mm mica crystals 30-40% of sample.

Sample 10a

Granular texture, particles 1.25mm or less, well-rounded frosted grains 70-80% of sample, flaked graphite 5% or less of sample, trace amounts of mica biotite, and a white fibrous mineral not identified.

Sample 11a

Crystalline texture, particles 1mm or less, angular white-to-gray semi translucent quartz 70% or sample, flaked graphite 10-15% or sample.

Sample 12a

Crystalline texture, particles 1mm or less, black two good planes of cleavage displayed vitreous luster pyroxene? 10 to 20% of sample, white-to-gray semi translucent quartz 5% or sample, mica and biotite 40% or sample, white one good plane of cleavage vitreous luster evident (unknown mineral) 10% of sample.

Sample 13a

Crystalline texture, particles 0.75mm or less, less than 0.25mm red garnet crystals, iron oxide pellets, angular clear-to-tan translucent quartz crystals, 0.1mm mica and biotite crystals also present.

Sample 14a

Crystalline texture, particles 1mm or less, white-to-semi translucent quartz 20% of sample, mica and biotite 40-50% of sample, white one good plane of cleavage vitreous luster evident (unknown mineral).

Marble Dissolution Procedure sheet

Purpose

Purpose of this study is to determine the difference in dissolution between the cave marble and limestone at Oregon Caves National Monument using varying techniques. The samples will be places in both in moving and still water sites and water sites of varying acidity to determine the difference in dissolution.

General Procedures

- Sample sizes for marble and limestone must be of equal size 1 inch cubes.

- Samples will be placed in the following locations in the cave chosen for various characteristics

	Room	Area within room	Reason for location	Special considerations for sample
Location 1				
Location 2				
Location 3				
Location 4				
Location 5				
Location 6				

- Samples are to be removed every __ days and weighed and measured

- Samples when removed from the cave are too be placed in marked bags marked with location of sample in the cave and the rock type.

- Sample weights and sizes are to be obtained and recorded every time the sample is removed from the cave, and any odd patterns of dissolution noted.

- Sample weights Sizes Comments will be recorded on a sample spread sheet entitled "2007_Marble_Disolution_Study_Sample_Sheet"

- the study will continue for ___ days at which point a study evolution will be conducted to determine the viability of the obtained results, and if necessary, continued at evaluators discursion.

Procedure for removing and pacing samples in the cave

When placing and removing the samples from the cave they are to be placed or removed using a set of tongs or sterile gloves and are to only be handled by one of these two items once the experiment is underway, no human contact. Once samples are placed in the removal bag and in the process of carrying them out be extremely careful not to break of chip the sample. To insure the safety in this each individual sample during transport in and out of the cave a double bagging system will be implemented. Each sample within its removal bag will be placed in a second bag with a type of padding to prevent any chipping or cracking as the sample is being transported.

-Procedures for placement of samples in moving water

-Procedures for placement of samples in still water

Samples are to be fully submerged under the water with only one surface touching the ground. The sample pairs need to be separated by at least __ to __ inches

-Procedures for placement of samples in dripping water

Sample is to be placed directly underneath the drip source. A second drip source of the same or nearly the same intensity and rate needs to be located and the second sample pair placed underneath it.

Procedure for obtaining size weight and characteristics

Each samples once removed safely form the cave will be brought up to the recourse cabin set out and allowed to air dry on a plastic sheet periodically turning the sample to ensure that all sides dry properly, no paper towels are to be used to ensure the most accurate weight is possible. Once air dried the sample can be weight and measured and carefully inspected for dissolution characteristics, handling is to be done only with sterile gloves the same as in the removal procedure. Once the sample observations are done the sample is to be placed back in it location in the cave using the sample removal and placing procedures. When the samples leaves the cave it should enter the cave again in five hours or less to in order to establish a set repeatable sampling time period

Safety considerations

Personal safety and cave safety issues come in when retrieving and pacing samples in the cave. The main human safety issues are working with extremely wet slippery areas of the cave where possibility one injuring themselves increases. For this reason two people are to conduct the placement and retrieval of samples portion of the study. One person is to retrieve the sample using the outlined procedure while the other carries the samples and ensures the safety of the partner and the cave.

This document outlines the purpose, procedures and safety considerations when conducting the marble dissolution study at Oregon Caves National Monument

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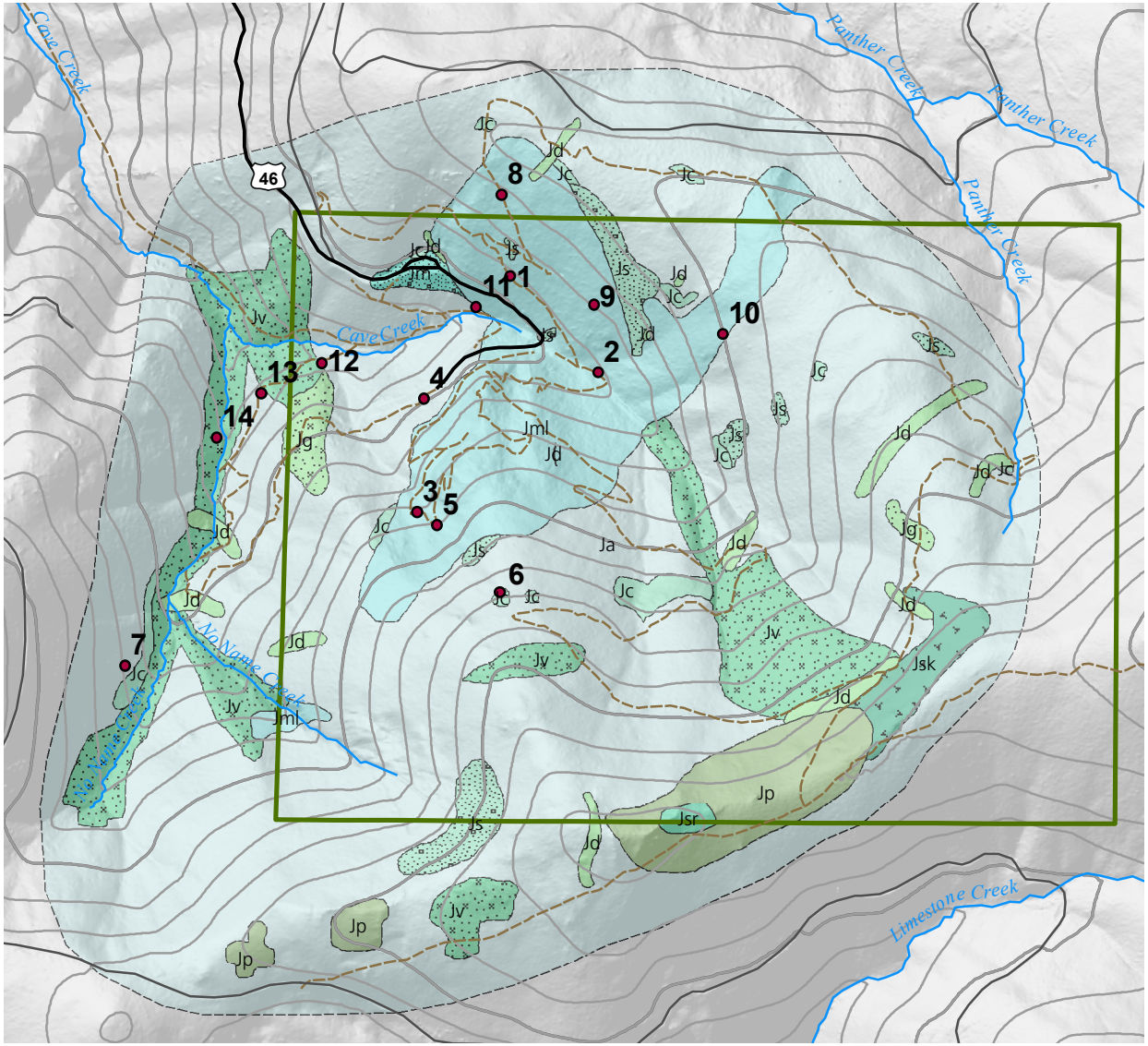
8/3/2007

Microfossil Sample Sites 2007



Legend

- Microfossil project
- Streams
- Forest Service Roads
- Caves Hwy
- Trails
- Current Boundary

Geology Contacts 2007

Rock type

- Jd - Diorite - Grayback Pluton Dikes (Late Jurassic)
- Jg - Gabbro - Grayback Pluton Dikes (Late Jurassic)
- Jsk - Skarn - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Jsr - Serpentinite - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Jp - Peridotite - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Jv - Metavolcanic - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Jml - Marble - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Jm - Melange - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Js - Metasediment - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Jc - Metachert - Rattlesnake Creek terrane (Middle to Late Jurassic)
- Ja - Argillite - Rattlesnake Creek terrane (Middle to Late Jurassic)

0 0.25 0.5 Miles

0 250 500 1,000 Meters

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Aug 2007

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