EXAMINATION OF BULK SOIL AND DETRITAL CHARCOAL FROM THE HURRICANE FAULT STUDY, UTAH

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INTRODUCTION

Five bulk soil samples from sites for the Hurricane Fault Study, Utah, were floated to recover organic fragments suitable for radiocarbon dating. Two detrital charcoal samples also were examined. Botanic components and detrital charcoal were identified, and potentially radiocarbon datable material was separated.

METHODS

The bulk samples were floated using a modification of the procedures outlined by Matthews (1979). Each sample was added to approximately 3 gallons of water. The sample was stirred until a strong vortex formed, which was allowed to slow before pouring the light fraction through a 150 micron mesh sieve. Additional water was added and the process repeated until all visible macrofloral material was removed from the sample (a minimum of 5 times). The material which remained in the bottom (heavy fraction) was poured through a 0.5 mm mesh screen. The floated portions were allowed to dry.

The light fractions were weighed, then passed through a series of graduated screens (US Standard Sieves with 4 mm, 2 mm, 1 mm, 0.5 mm and 0.25 mm openings to separate charcoal debris and to initially sort the remains. The contents of each screen were then examined. Charcoal pieces larger than 1 mm in diameter were broken to expose a fresh cross-section and examined under a binocular microscope at a magnification of 70x. The remaining light fraction in the 4 mm, 2 mm, 1 mm, 0.5 mm, and 0.25 mm sieves was scanned under a binocular stereo microscope at a magnification of 10x, with some identifications requiring magnifications of up to 70x. The material which passed through the 0.25 mm screen was not examined. The coarse or heavy fractions also were screened and examined for the presence of botanic remains. Remains from both the light and heavy fractions were recorded as charred and/or uncharred, whole and/or fragments. Individual detrital charcoal/wood samples also were broken to expose a fresh cross-section and examined under a binocular microscope at a magnification of 70x.

Macrofloral remains, including charcoal, were identified using manuals (Core et al. 1976; Martin and Barkley 1973; Panshin and Zeeuw 1980; Petrides and Petrides 1992) and by comparison with modern and archaeological references. The term "seed" is used to represent seeds, achenes, caryopses, and other disseminules. Because charcoal and possibly other botanic remains were to be sent for radiocarbon dating, clean laboratory conditions were used during flotation and identification to avoid contamination. All instruments were washed between samples, and samples were protected from contact with modern charcoal.

DISCUSSION

Bulk sediment and detrital charcoal samples were examined from three sites for the Hurricane Fault Study, Utah. Three soil profiles in stream cuts were sampled at the Middleton site. Local vegetation in this area consists of a pinyon (*Pinus edulis*)/juniper (*Juniperus*) forest with sagebrush (*Artemisia*), probable willows (*Salix*), grasses (Poaceae), and other small bushes.

Pine (*Pinus*), fir (*Abies*), spruce (*Picea*), and oak (*Quercus*) are noted at higher elevations in the drainage basin. Two detrital charcoal samples and three bulk sediment samples were recovered from this site.

Sample MS1-1 represents bulk sediment from the B horizon at a depth of 25-92 cm (Table 1). This sample contained two charred *Pinus* needle fragments (Tables 2 and 3); however, these needle fragments were too small for even AMS radiocarbon dating. A few uncharred *Juniperus* leaf fragments represent modern juniper trees. Uncharred roots and rootlets from other modern plants also were present. The charcoal record from this sample contained a variety of charcoal, dominated by conifer charcoal too small to identify to genus. Pieces of *Artemisia*, *Juniperus*, *Pinus*, Salicaceae, and charcoal too small to identify also were present. While none of the identifiable charcoal types alone were present in sufficient quantity for AMS radiocarbon dating, combining the various charcoal types would yield enough charcoal for AMS radiocarbon dating. The minimum requirement of charcoal for AMS radiocarbon dating reported by Beta Analytic, Inc. is 5 mg or 0.005 g. Non-floral remains noted in this sample include insect chitin fragments and an abundance of rock/gravel.

Sample MS2-1 consists of material from a thin, buried A horizon at a depth of 17.5-20.5 cm. This small sample contained very small pieces of conifer and unidentifiable charcoal; however, this charcoal was not present in sufficient quantities for AMS radiocarbon dating. The sample did contain uncharred rootlets from modern plants, a few pieces of rock/gravel, a moderate amount of sand, and a few worm casts.

Sample MS2-3 contains charcoal from a thin burn horizon at a depth of 103.5 cm. Pieces of *Juniperus* root charcoal indicate that this horizon does represent a burned root. This charcoal may be submitted for AMS radiocarbon dating. Uncharred rootlets from modern plants, a few pieces of rock/gravel, and sand complete the record.

Bulk sample MS3-1 represents an A horizon at a depth of 15-23 cm that is buried by what appears to be a recent sheetwash deposit. This sample contained charred *Juniperus* seed fragments and charred bark fragments that are present in sufficient quantities for AMS radiocarbon dating. Uncharred roots and rootlets represent modern plants. *Juniperus* dominated the charcoal record in this sample, with smaller amounts of *Artemisia*, probable *Cercocarpus*, *Quercus*, Salicaceae, and unidentified charcoal present. The individual quantities of *Juniperus* and probable *Cercocarpus* charcoal may be submitted for AMS radiocarbon dating, or charcoal types may be combined. Non-floral remains present in this sample include insect chitin fragments and an abundance of rock/gravel and sand.

Pieces of *Juniperus*, *Pinus*, Rosaceae, and unidentified charcoal were each present in sufficient quantities for AMS radiocarbon dating in bulk sample MS3-2 from a buried A horizon at a depth of 117-139 cm. Three pieces of uncharred *Juniperus* root wood also were present. An uncharred *Juniperus* leaf fragment, roots, and rootlets represent modern plants. A living insect larva, uncharred insect fecal pellets, and insect chitin fragments suggest some disturbance to this area from insect activity. The sample also contained an abundance of rock/gravel.

One bulk sample from one soil profile was examined from a stream cut at the Bauer site. Vegetation in this area consists mainly of pinyon and juniper, with some willow present. Higher elevations in the drainage basin may contain pine, fir, spruce, and oak.

Bulk sample MB1-1 was taken from the B horizon at a depth of 13-60 cm. This sample contained a variety of charcoal types, including *Amelanchier*, *Artemisia*, conifer, *Quercus*, Salicaceae, unidentified diffuse porous, unidentified root, and unidentifiable charcoal. Only the unidentified diffuse porous charcoal was present in sufficient quantities alone to provide an AMS radiocarbon date; however, charcoal types may be combined to obtain enough charcoal for AMS radiocarbon dating. Uncharred plant remains in this sample include a few *Juniperus* leaf fragments, pieces of conifer-type bark, roots, rootlets, and unidentified root wood. Two insect chitin fragments and an abundance of rock/gravel and sand complete the record.

One sample from one soil profile also was examined from a south-facing stream cut at the Coyote Gulch site. A pinyon/juniper forest is found in this area, with sagebrush, grasses, and other small bushes. Again, the higher elevations may contain pine, fir, spruce, and oak. Bulk sample CG1-1 represents the B horizon at a depth of 15-128 cm. Very small pieces of *Artemisia*, *Juniperus*, and charcoal too small to be identified were present in this sample. Even when combined, the charcoal in this sample may be insufficient for AMS radiocarbon dating. The sample also contained a charred *Juniperus* leaf fragment and a few uncharred *Juniperus* leaf fragments, as well as uncharred roots and rootlets from modern plants, insect chitin fragments, and an abundance of rock/gravel and sand.

SUMMARY AND CONCLUSIONS

Examination of bulk sediment and detrital charcoal from three sites for the Hurricane Fault Study in Utah resulted in recovery of charcoal and other charred botanic remains that may be sent for AMS radiocarbon dating. Charred remains represent local plants, as well as plants from higher elevations in the drainage basin.

TABLE 1
PROVENIENCE DATA FOR SAMPLES FROM THE HURRICANE FAULT STUDY, UTAH

Site	Sample No.	Depth	Description
Middleton	MS1-1	25-92 cm	Bulk sediment from B horizon
	MS2-1	17.5-20.5 cm	Detrital charcoal from buried A horizon
	MS2-3	103.5 cm	Detrital charcoal from thin burn horizon (possible root)
	MS3-1	15-23 cm	Bulk sediment from buried A horizon
	MS3-2	117-139 cm	Bulk sediment from A horizon
Bauer	MB1-1	13-60 cm	Bulk sediment from B horizon
Coyote Gulch	CG1-1	15-128 cm	Bulk sediment from B horizon

TABLE 2
MACROFLORAL REMAINS FROM THE HURRICANE FAULT STUDY, UTAH

Sample No.	Identification	Part	Charred		Uncharred		Weights/ Comments
			W	F	W	F	
MIDDLETON SITE							
MS1-1	Liters Floated						2.30 L
25-92 cm	Light Fraction Weight						13.44 g
	FLORAL REMAINS:						
	Pinus	Needle		2			<0.001 g
	Juniperus	Leaf				X	Few
	Rootlets					X	Moderate
	Roots					X	Numerous
	CHARCOAL/WOOD:						
	Artemisia	Charcoal		2			<0.001 g
	Conifer	Charcoal		21			0.003 g
	Juniperus	Charcoal		3			0.001 g
	Pinus	Charcoal		5			0.003 g
	Salicaceae	Charcoal		1			<0.001 g
	Unidentifiable - small	Charcoal		X			0.025 g
	NON-FLORAL REMAINS:						
	Insect	Chitin				20	
	Rock/Gravel					X	Abundant
MS2-1	Volume Floated						20 ml
17.5-20.5 cm	Light Fraction Weight						0.47 g
	FLORAL REMAINS:						
	Rootlets					X	Few
	CHARCOAL/WOOD:						
	Conifer	Charcoal		1			<0.001 g
	Unidentifiable - small	Charcoal		X			<0.001 g
	NON-FLORAL REMAINS:						
	Rock/Gravel					X	Few
	Sand					X	Moderate
	Worm casts				X		Few

TABLE 2 (Continued)

Sample No.	Identification	Part	Charred		Uncharred		Weights/ Comments
			W	F	W	F	
MS2-3	Volume Floated						20 ml
103.5 cm	Light Fraction Weight						1.70 g
	FLORAL REMAINS:						
	Rootlets					X	Few
	CHARCOAL/WOOD:						
	Juniperus root	Charcoal		35			0.240 g
	NON-FLORAL REMAINS:						
	Rock/Gravel					X	Few
	Sand					X	Moderate
MS3-1	Liters Floated						1.80 L
15-23 cm	Light Fraction Weight						19.45 g
	FLORAL REMAINS:						
	Juniperus	Seed		8			0.027 g
	Bark			16			0.024 g
	Rootlets					X	Numerous
	Roots					X	Numerous
	CHARCOAL/WOOD:						
	Artemisia	Charcoal		1			<0.001 g
	cf. *Cercocarpus*	Charcoal		2			0.011 g
	Juniperus	Charcoal		30			0.071 g
	Quercus	Charcoal		2			0.003 g
	Salicaceae	Charcoal		1			0.003 g
	Unidentified	Charcoal		X			0.050 g
	NON-FLORAL REMAINS:						
	Insect	Chitin				15	
	Rock/Gravel					X	Abundant
	Sand					X	Abundant
MS3-2	Liters Floated						2.10 L
117-139 cm	Light Fraction Weight						24.10 g
	FLORAL REMAINS:						
	Juniperus	Leaf				1	
	Rootlets					X	Numerous
	Roots					X	Moderate

TABLE 2 (Continued)

Sample No.	Identification	Part	Charred		Uncharred		Weights/ Comments
			W	F	W	F	
MS3-2	CHARCOAL/WOOD:						
117-139 cm	*Juniperus*	Charcoal		12			0.062 g
	Pinus	Charcoal		6			0.040 g
	Rosaceae	Charcoal		4			0.024 g
	Unidentified	Charcoal		X			0.024 g
	Juniperus root	Wood				3	0.011 g
	NON-FLORAL REMAINS:						
	Insect	Chitin				24	
	Insect fecal pellets				X	X	Moderate
	Insect (living)	Larva			1		
	Rock/Gravel					X	Abundant
BAUER SITE							
MB1-1	Liters Floated						2.70 L
13-60 cm	Light Fraction Weight						20.65 g
	FLORAL REMAINS:						
	Juniperus	Leaf				X	Few
	Conifer-type	Bark				X	Moderate
	Rootlets					X	Numerous
	Roots					X	Moderate
	CHARCOAL/WOOD:						
	Amelanchier	Charcoal		2			0.002 g
	Artemisia	Charcoal		1			0.002 g
	Conifer	Charcoal		2			<0.001 g
	Quercus	Charcoal		8			0.002 g
	Salicaceae	Charcoal		2			0.001 g
	Unidentified diffuse porous	Charcoal		6			0.008 g
	Unidentified root	Charcoal		2			<0.001 g
	Unidentifiable	Charcoal		X			0.019 g
	Unidentified root	Wood				2	
	NON-FLORAL REMAINS:						
	Insect	Chitin				2	
	Rock/Gravel					X	Abundant
	Sand					X	Abundant

TABLE 2 (Continued)

Sample No.	Identification	Part	Charred		Uncharred		Weights/ Comments
			W	F	W	F	
COYOTE GULCH SITE							
CG1-1	Liters Floated						2.70 L
15-128 cm	Light Fraction Weight						26.22 g
	FLORAL REMAINS:						
	Juniperus	Leaf		1		X	Few
	Rootlets					X	Moderate
	Roots					X	Numerous
	CHARCOAL/WOOD:						
	Artemisia	Charcoal		1			<0.001 g
	Juniperus	Charcoal		4			0.002 g
	Unidentifiable - small	Charcoal		X			<0.001 g
	NON-FLORAL REMAINS:						
	Insect	Chitin				23	
	Rock/Gravel					X	Abundant
	Sand					X	Abundant

W = Whole
F = Fragment
X = Presence noted in sample
g = grams
ml = milliliters

TABLE 3
INDEX OF MACROFLORAL REMAINS RECOVERED IN SAMPLES FROM
THE HURRICANE FAULT STUDY, UTAH

Scientific Name	Common Name
FLORAL REMAINS:	
Juniperus	Juniper
Pinus	Pine
CHARCOAL/WOOD:	
Artemisia	Sagebrush
Conifer	Cone-bearing, gymnospermous trees and shrubs, mostly evergreens, including the pine, spruce, fir, juniper, cedar, yew, and cypress
Juniperus	Juniper
Pinus	Pine
Quercus	Oak
Rosaceae	Rose family
Amelanchier	Juneberry, Serviceberry
cf. *Cercocarpus*	Mountain mahogany
Salicaceae	Willow Family

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HURRICANE FAULT STUDY
SOIL SAMPLES COLLECTED FOR CHARCOAL IDENTIFICATION
December 23, 1999

Kathy,

Enclosed are 7 samples for charcoal identification. I'm not interested in modern material, only old charcoal that will help me determine the age of the deposits from which the samples were collected. There are 5 bulk soil samples (MS1-1, MS3-1, MS3-2, MB1-1, & CG1-1) and two samples of charcoal in film cannisters (MS2-1 & MS2-3). The Purchase Order number for billing purposes is **305064**. I realize you are very busy, but would appreciate any thing you could do to help move these along, my final report is due the end of April. If things look like they may really slow down please give me a call. Thanks, and have a Happy Holidays.

Bill Lund

Middleton Site (T37S., R11W, SE1/4 Sec. 4 SLB&M): Three soil profiles (MS1, MS2, and MS3) were described and sampled at the Middleton site. All three profiles were measured in stream cuts that I cleaned and notched back to a vertical face. The profiles are within 75 meters of each other along the stream; MS1 is the westernmost, MS3 is the easternmost. Vegetation at the site consists of a pinion and juniper forest with abundant sagebrush and small willows (?) in the stream channel itself. There are a variety of grasses and other small bushes present, but I cannot identify them. The site is at an elevation of ~6,100 feet, but the drainage along which I measured the profiles extends to the top of the Hurricane Cliffs at 9,500 feet plus elevation. Pine, fir, spruce, and oak are present at higher elevations in the drainage basin. Descriptions follow for the enclosed samples:

MS1-1: Bulk sample from B horizon collected between 25-92 cm. The sample interval appears to consist of a single fine-grained, fluvial unit on which moderately developed Bt and Bk horizons have formed. The sample contains some modern roots and the sample interval contained insect burrows (yellow jackets?) in the upper 30 or 40 cm.

MS2-1 Film cannister containing organic-rich material (charcoal?) from a buried A horizon at 17.5-20.5 cm; horizon was too thin to take a bulk sample. The A horizon is overlain by what appears to be a sheetwash deposit on which a very weakly developed modern A horizon has begun to form. The sample contains some modern roots.

MS2-3 Film cannister containing charcoal from a thin burn horizon

(root??) at a depth of 103.5 cm; the burn layer is horizontal and ~ 3 cm thick and 65 cm long. At this location, the stream cut contains at least three and possibly four debris-flow units. The burn layer from which this sample was collected may be at the contact between two of those units. However, there is a possibility that it is a burned root. I also collected a bulk sample (MS2-2) from this horizon but am not including it with this batch of samples.

MS3-1 Bulk sample from a buried A horizon at 15-23 cm. The A horizon is buried by what appears to be a recent sheetwash deposit, I could identify no evidence of soil formation on the sheetwash material. The sample contains modern roots.

MS3-2 Bulk sample from a buried A horizon at 117-139 cm. The A horizon is formed on an older, coarse debris-flow deposit and is overlain by a coarse, stratified fluvial unit. The sample contains some modern roots.

Bauer Site (T37S., R11W, SW1/4 Sec. 17 SLB&M): One soil profile was described at the Bauer site. The profile was measured in a stream cut that I cleaned and notched to a vertical face. Vegetation is chiefly pinion and juniper with some willow; sagebrush is rare to absent at this site. The site is at an elevation of ~ 6,300 feet. The stream along which the profile was measured also drains from the Hurricane Cliffs and may contain pine, fir, spruce, and oak at higher elevations

MB1-1 Bulk sample from B horizon collected between 13 and 60 cm. The sample interval appears to consist of a single fine-grained, fluvial unit on which moderately developed Bw and Bk horizons have formed. The sample contains modern roots and insect burrows.

Coyote Gulch Site (T37S., R12W, SW1/4 Sec. 24 SLB&M): One soil profile was described from the Coyote Gulch site. It was measured in a south-facing stream cut that I cleaned and notched to a vertical face. Vegetation at the site consists chiefly of a pinion and juniper forest with abundant sagebrush. There are no willows along the stream channel. There are a variety of grasses and other small bushes present, but I cannot identify them. The site is at an elevation of ~5,760 feet, but the drainage along which I measured the profiles drains from the Hurricane Cliffs and may contain pine, fir, spruce, and oak at higher elevations in the drainage basin.

CG1-1 Bulk sample from B horizon collected between 15 and 128 cm. The sample interval consists of a numerous thin strata each probably deposited by a sheetwash or minor flood event to form a generally fine-grained fluvial unit on which weakly developed Bw

and Bk horizons have formed. The sample contains modern roots but I observed no evidence of burrowing by insects or other critters.