INDEPENDENT SOMETIMES?

M8 and M9
300 yr avg
same quake
500 yr avg

Time

500 km
Harry Williams and Ian Hutchinson (ca 2000, by Alan Nelson)
300 YR AVG at Discovery Bay?

≤ 8 recurrence intervals in preceding 2,500 yr

Alternative reading of Williams et al. (2005)
RARELY INDEPENDENT

Goldfinger et al. (2008, 2012)
SENSITIVITY of northern turbidites to earthquake size and rate

Context

Confluence

Conduits

Chronology
CONTEXT affects sensitivity to rate?

Number of post-Mazama turbidites

3 km

Cascadia and Quinault

13

≥14 perched

14

3 km

Rogue

30-31

100 km on profiles

more in fig. 1 at pubs.usgs.gov/of/2012/1043/
CONFLUENCE

One long rupture
Two equal tributaries

One merged flow

Adams (1990)
CONFLUENCE

One long rupture
Two equal tributaries

Juan de Fuca
Quinault, Willapa
Cascadia

JdF QW C

One merged flow

100 km

Adams (1990)
C turbidites from JdF, QW, or both?

Turbidite
Hemipelagic clay

6609-24

100 km

1 m

Clay  Silt  Sand

Ash
JdF SIGNATURE

100 km

JdF

C

QW

CZS

Turbidites sandy in nearby cores M9907-11 and -12

Pleist

1 m

Ash

see fig. 4 at pubs.usgs.gov/of/2012/1043/
LONG-HELLED VIEW

Two equal tributaries

16-19
14
15
14
13
13

post-
Mazama
flows

13 merged flows
13 ruptures JdF + QW

Adams (1990); data of Griggs (1969) and Barnard (1973)
ALTERNATIVE VIEW

Two unequal tributaries

post-Mazama flows

13 large QW flows
13 ruptures QW + ?

Columbia River sediment

more in fig. 4 at pubs.usgs.gov/of/2012/1043/
CONDUITS

Pulses similar in multiple canyon heads

a, During earthquake

b, Hours later

1 cm
ALTERNATIVE: SEISMIC DETAILS LOST

Shaking varies along and across strike

Initial mass movements respond to cumulative shaking and are prone to delay

Flows transformed by
- changes in slope
- erosion of bed
- division at bends
- staggered merger
TO HELP ASK WHETHER THE LOGS MATCH

Data of Goldfinger et al. (2012)
<table>
<thead>
<tr>
<th>J1</th>
<th>J2</th>
<th>J3</th>
<th>J4</th>
<th>J5</th>
<th>J6</th>
<th>J7</th>
<th>J8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
</tr>
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</tr>
</tbody>
</table>

MATCH?

350 km

4 km

20 cm

M9907-12, -11

M9907-25, -23, -22
ANOTHER MATCH?

350 km

4 km

20 cm

J1  
J2  
J3  
J4  
J5  
J6  
J7  
J8  

C1  
C2  
C3  
C4  
C5  
C6  
C7

no deposit

more in fig. 5 at pubs.usgs.gov/of/2012/1043/
...and adjust the foram age to estimate the time of the turbidity current.

Date hemipelagic forams...

**Challenges**
- Erosion and deformation
- Sample thickness and slow sed rate
- Mixing

1 cm

Strategy of Gutierrez-Pastor et al. (2008)
ADJUSTMENTS in Cascadia Channel

<table>
<thead>
<tr>
<th>Turbidite</th>
<th>C8</th>
<th>C6</th>
<th>C4</th>
<th>C1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foram age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shift (yr)</td>
<td>362</td>
<td>392</td>
<td>380</td>
<td>91</td>
</tr>
<tr>
<td>Adjusted age</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reported uncertainty scarcely affected by shift

see figs. 6-8 at pubs.usgs.gov/of/2012/1043/
FOR THE LOGIC TREE

M8 and M9
300 yr avg
same quake
500 yr avg

Time
THANK-YOU

John Adams  Harvey Kelsey
Bill Burns    Steve Kirby
Jody Bourgeois  Pat McCrory
Bob Butler    Ann Morey
Jason Chaytor  Alan Nelson
Jane Cienner  Jim Phipps
Jake Covault  David Piper
Art Frankel   Garry Rogers
Chris Goldfinger  Ben Sheets
Tark Hamilton  Uri Ten Brink
Jim Hendley   Kelin Wang
Roy Hyndman   Yumei Wang
Paul Johnson  Craig Weaver
Sam Johnson   Ivan Wong

Precision depth recorder