Unearthing clues of catastrophic earthquakes

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The destruction and disappearance of ancient cultures mark the history of human civilization, making for fascinating stories and cautionary tales. The longevity of today's societies may depend upon separating fact from fiction, and archeologists and seismologists are figuring out how to join forces to do just that with respect to ancient earthquakes, as detailed in new studies presented at the international conference of the Seismological Society of America.

"It's an idea whose time has come, " said Robert Kovach, professor of geophysics at Stanford University and a leading proponent that seismology needs to be included in any framework for understanding what happened to past civilizations. Very large earthquakes may have recurrence rates that exceed 500 years, making it very difficult to assign potential hazard estimates.

Archaeoseismology, a young scientific discipline that studies past earthquakes in the archaeological record, allows scientists to broaden the time window to detect these rare seismic catastrophic events. But archaeological evidence for past earthquakes raises a lot of reservations from seismologists, some of them strongly questioning whether man-made structures can be used as earthquake indicators at all.

Controversy stems from what is seen by some seismologists as haphazard blame placed on earthquakes by archaeologists for inexplicable phenomena on an archaeological site, adding drama to the site's history. "We need to be wary of circular reasoning" said Tina Niemi, a geologist at the University of Missouri-Kansas City, who noted the temptation to

assign evidence to match a preconceived notion that an earthquake may have caused damage.

“We are indeed at a turning point with respect to archaeoseismology -- either earthquake evidence in archaeological sites remains in a world of conjecture and drama or a more objective and quantitative approach gets the upper hand,” said Manuel Sintubin, professor of geodynamics at Katholieke Universiteit Leuven in Belgium.

Earlier this month UNESCO awarded a five-year grant to Sintubin and his colleagues Niemi; Iain Stewart, geologist at University of Plymouth in the United Kingdom; and Erhan Altunel, geologist at the Eskisehir Osmangazi University in Turkey, to support archaeoseismology by broadening the field’s primary focus from the Near East to include the Far East.

“The importance of this effort is to create a long-term, worldwide platform for a broad multidisciplinary discussion on archaeoseismology. Our final objective is to assure that archaeoseismology will be considered as a legitimate and complementary source of seismic-hazard information.”

There is still much to be known about ancient earthquakes. The instrumental record for seismology is short, going back 100 years. The historical seismology record is a much longer, including written documentation such as news accounts and diaries, which vary widely by culture and region. The archeoseismic record serves as the bridge between historical accounts and the paleoseismic record of Earth’s history.

“It's important to society to understand the risks posed by earthquakes with longer repeating cycles,” said Kovach. "Unless the world was drastically different than today, then it’s inconceivable that earthquakes

did not play a role in the past to affect the cultures that occupied the land along the faults, some of which we do not even know of yet," said Kovach.

Seismologists look for evidence that suggest an earthquake's footprint. Sintubin and Niemi cite three distinct types of evidence: faulted and displaced archaeological relics, or "cultural piercing features"; ground-shaking induced damage to buildings and damage induced by secondary phenomena, such as tsunamis; and archaeological evidence, such as repairs to man-made structures.

Kovach looks at the issue of water, such as the damming of rivers and changing elevation of coasts. His research has focused on Banbhore, which is an inland city that was once the ancient coastal city of Debal, the gateway for Islam's advent in the Indian subcontinent. According to Kovach, the site has witnessed at least four distinct Muslim occupations and three successive reconstructions that correlate to the written record by Arab historians. "There are numerous examples in the Indus Valley that earthquakes did affect the occupying history of these sites," said Kovach. Today, most of Pakistan and the western states of India occupy the ancient Indus Valley, which experienced the earthquakes that, according to Kovach, altered the course of civilization there over the past millennium.

Sintubin and Stewart are proposing a standardized method to study an archaeological site with the purpose of identifying ancient earthquakes and to evaluate existing archaeoseismological data. The research is currently in process for publication by the Bulletin of the Seismological Society of America. Called the Archeological Quality Factor, or AQF, this proposed evaluative approach would document a degree of certainty of an ancient earthquake recorded at a site. According to Sintubin, the approach reveals the weaknesses in any earthquake hypothesis at a site and constitutes a significant step in the overall acknowledgement of

archaeoseismology as a scientific discipline. Sintubin applied the method to research conducted at an excavation in Turkey. The resulting AQF (~5%) turns out to support with some certainty the hypothesis that the region has been struck in the 7th century AD by a previously unknown major earthquake.

While some remain cautious, others are eager to refine the role of earthquakes on past cultures. “A lot can be gleaned from going back to look at old reports,” said Kovach. “Past earthquakes have left an inviting tale of destruction.”

Source: Seismological Society of America