



THE FORGOTTEN EARTHQUAKE OF 1440 AD IN ISTRIA - ARCHAEOSEISMOLOGICAL EVIDENCE FROM THE EUPHRASIUS CATHEDRAL, POREČ, CROATIA

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ABSTRACT: The Istria Peninsula in the northern Adriatic Sea (shared by Croatia and Slovenia) is considered to be a nearly aseismic part of the Adriatic microplate, as opposed to the seismically active frontal ranges of the Dinaric orogen. We present new archaeoseismological data from the Medieval Euphrasius Cathedral in Poreč, which supports an unknown intensity earthquake in 1440 AD. The earthquake caused the southern aisle of the cathedral to collapse, resulting in permanent damage to the marble columns. Set in the context of regional seismicity and tectonic activity, the Istria peninsula cannot be omitted from regional seismic zoning studies.

Keywords: historical earthquake, archaeoseismology, earthquake damage, Istria, Croatia.

1. INTRODUCTION

The Istria Peninsula is the northeastern surface expression of the Adriatic microplate, separated from the Dinaric Mountains by multiple thrust faults (Placer et al., 2010). The coastal Dinarides are characterized by intense seismicity (Fig. 1), whereas the Istria region appears conspicuously aseismic. Its seismic quiescence is so pronounced that Istria was not even assigned a separate block in the Croatian seismogenic source map (Markušić & Herak, 1999). Motivated by the lack of both instrumental evidence for earthquakes and relevant data in earthquake catalogues, we initiated a systematic survey of Istria using the method of archaeoseismology. We argue that the rich Medieval built heritage of the region provides ample information on the presence or absence of earthquakes in the past two thousand years.

Parentium (Latin: Parentium, Italian: Parenzo, Croatian: Poreč) was a small, ordinary coastal city of the Byzantine Empire in Late Antiquity. Its episcopal complex, however, is one of a handful of Justinianic monuments to survive essentially intact, and thus it holds a unique position in the art and architecture of the Early Christian era. In addition to the excellent physical condition of the individual buildings and decorative features, the extent of what survives - an entire cathedral complex - is virtually unparalleled (Terry, 1984; Prelog, 1986, 2004; Matejčić, 2014). The complex encompasses a basilica (Fig. 2), an atrium, an episcopal palace, and a triconch chapel. The surviving decorative program includes architectural sculpture, furnishings, and stucco, along with the well-known and superbly preserved wall and floor mosaics (Terry & Maguire, 1998, 2000, 2001, 2007). This led UNESCO to inscribe the cathedral on the World Heritage List in 1997.

The cathedral complex is located in the northwestern quadrant of the city, on a site which borders the shoreline (45°13'43"N, 13°35'36"E). In

accord with Christian practice, the basilica is oriented east-west. The ground plan forms a slightly irregular rectangle, measuring approximately 19.5 m in width and 38 m in length. Two colonnades, each composed of nine columns, screen the wide central nave from its two narrower, flanking side aisles (Fig. 3). At the east, nave and aisles terminate in apses. The main apse projects externally, enclosed by a hexagonal wall; the side apses are inscribed in the masonry of the eastern wall. A ciborium - a baldachin-like masonry construction built in 1277 - occupies a central position in the apse; the altar is directly below the ciborium (Terry, 1984).

A modern pavement covers both the nave and the side aisles. Scattered through the interior are a number of openings left behind by archaeological excavations, which provide access to floor mosaics and other features from earlier church buildings at the same site (Molajoli, 1940, 1943; Terry, 1984; Matejčić & Chevalier, 1998).

In elevation, the central nave projects above the side aisles. The nave stands ca 18 m tall. The side aisles rise to a height of ca. 11 m. Blind arcades run along the northern facade, both on the aisle and nave walls. The arcades correspond to the interior colonnade. The south facade presents a dramatically different appearance. The nave wall, devoid of arcades, is broken only by five Gothic, pointed-arc windows. The south aisle, on the other hand, has blind arcades (Terry, 1984).

The basilica, in its current form, was built by Bishop Euphrasius, who lived in the mid-sixth century. He is mentioned by Pope Pelagius I in a letter dated 559 AD. An inscription and donor portrait in the apse of the basilica credit Bishop Euphrasius with the foundation of the church. For a discussion of dating, see Terry (1984:150-59, with bibliography); also Terry (1986, 1988).

Historical records indicate that in 1440, the basilica

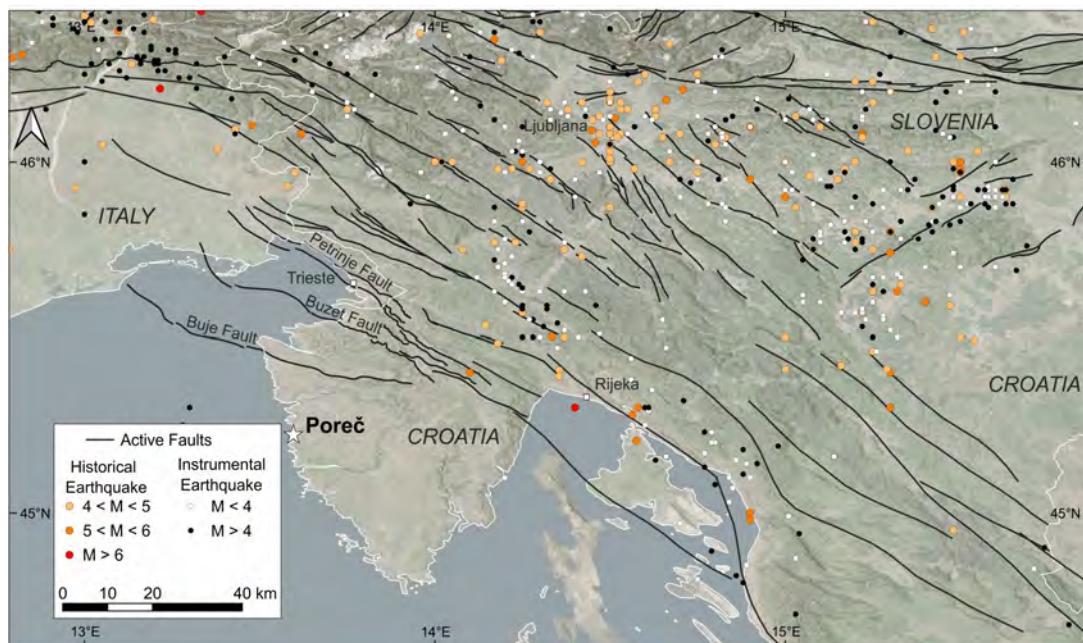


Fig. 1 - The location of Poreč in Croatia in the background of historical earthquakes (1000-1899) based on the European Pre-Instrumental Earthquake Catalogue EPICA (Rovida et al., 2022), instrumental SHARE European Earthquake Catalogue (SHEEC) for the time period 1900-2006 (Grünthal et al., 2013), and active faults based on Atanackov et al. (2021) and European Fault-Source Model 2020 (EFSM20; Basili et al., 2022).



Fig. 2 - View of Euphrasius Cathedral from the western forecourt, the narthex. Archaeoseismological Database (ADB) photo #2097 (Kázmér & Gaidzik, 2023).

suffered significant damage from an earthquake (Babudri, 1913:129; Cuscito, & Galli, 1976). The upper part of the nave wall and most of the south aisle were toppled. The columns of the south aisle sustained some damage, while the stucco relief work on the intrados, the

inner curves of the arches of the south colonnade was completely destroyed. The nave was rebuilt, and it was at this time that pointed-arch windows were introduced (Fig. 3) (Terry, 1984: 14, and footnote 34). These repairs were initiated by Bishop Giovanni (1440-1457) and completed by Bishop Placido Pavanella (1457-1461) (Babudri, 1910: 247-249). The successive efforts of these bishops could not stop the general decline that was to characterize the next three centuries in the history of the Euphrasiana. Occasional outbreaks of the plague gradually reduced the population and impoverished the city. The artistic value of the mosaics was recognized early, and repeated archaeological studies and restorations occurred from the late 19th century onwards (Terry, 1995; Terry & Muhlstein, 1998; Terry & Eaves, 2001; Bernardi, 2006).

Although a Medieval record of a single earthquake event was known, it has not been used until now. Visiting engineers found the 'tell-tale' evidence for the 1440 earthquake unconvincing (e.g., the presence of Gothic windows in the southern wall of the Romanesque cathedral) (Ivan Matejčić, pers. comm., 2014). Here we present a broader set of further evidence in support of the 1440 earthquake, and use the data to assess earthquake parameters.

2. METHODS

Archaeoseismology is the study of past earthquakes based on the damage left behind in buildings; both standing buildings and archaeological sites can be used to identify seismic damage. Standard methods exist for assessing seismic damage by surveying deformed upright walls and floors (Stiros, 1996; Galadini et al., 2006; Sintubin, 2011; Kázmér, 2015; Kázmér et al., 2023).

Medieval buildings, mostly churches, can also record past earthquakes (e.g., Hinzen et al., 2013; Bottari et al., 2020; Korzhenkov et al., 2020). Toppled walls, dropped keystones, in-plane and out-of-plane

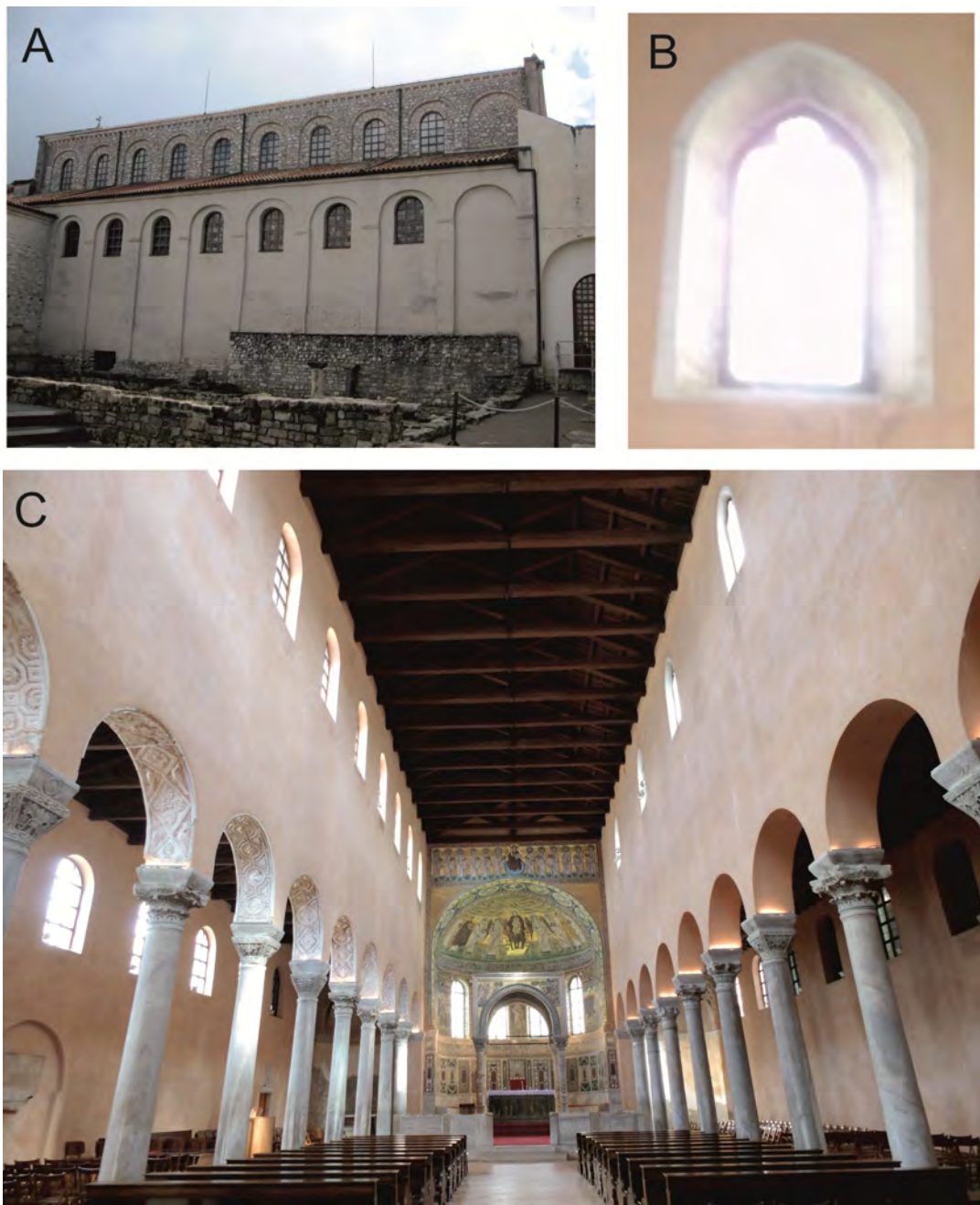


Fig. 3 - Views of the Byzantine cathedral of Euphrasius in Poreč (6th century AD). **A.** Romanesque, rounded-arch windows are on the northern facade. ADB photo #2212. **B.** Gothic, pointed-arch window of the southern facade, photographed from the inside. ADB photo #0123. **C.** View of the nave towards the east. The famous Byzantine mosaics are in the apse and above the triumphal arch in front. The northern walls (left) have Romanesque, rounded-arch windows only. The southern wall (right) has half as many Gothic, pointed-arch windows. Stucco work decorates the soffits of the arches between columns of the northern wall (left); these are missing in the southern wall (right). Both the nave and the aisles are covered with a wood truss roofing system. Columns are vertical; image distortion is due to wide-field-of-view photography. ADB photo #DSCI0111.

displacement of masonry ashlar are ancient seismoscopes (Korzhnikov & Mazor, 2017). Beyond obvious damage features, conspicuous changes in the construction process, deviation from accepted norms, and extensive repair and reconstruction can be revealed by establishing a building stratigraphy. This creates a history of the buildings in terms of construction - destruction - reconstruction, and allows us to recognize the effects of several subsequent earthquakes if the need arises. These features record seismic parameters:

date, damage location, intensity, and strong motion direction (e.g., Korjenkov et al., 2003; Hinzen et al., 2016; Martín-González, 2018, 2021; Kim et al., 2023). Intensity was assessed via the comparative table of Rodríguez-Pascua et al. (2013, 2016, 2022). It assigns a minimum intensity value to each type of seismic damage, comparing these with the EMS-98 scale (Grünthal et al., 1998).

The seismic origin of various deformations can be proven by analogue (Vasconcelos et al., 2006) and

numerical modelling (Hinzen et al., 2016). Typology and comparison with similar features of deformation stored in the Archaeoseismological Database (Kázmér & Gaidzik, 2023) help identify seismic deformation. Archaeoseismology relies heavily on the common ways of thinking among geologists, archaeologists, and historians. Specialists in these fields are all aware that only a tiny fraction of information is preserved for drawing the historical picture of seismicity. One needs to formulate an interpretation that does not contradict any existing data and, hopefully, will not contradict new data to be found in the future.

The cathedral was surveyed using a compass, tape measure, a constructor's tiltmeter, a Leica Disto D8 handheld laser distance meter, and a Laser Technology TriPulse 360B laser range finder. These measures routinely provide accuracy of ± 1 cm and 10 cm, respectively. We measured the dimensions and azimuth of various discontinuity surfaces on the marble columns.

3. RESULTS

In the following we describe various deformation features observed on the Euphrasius cathedral, following the archaeoseismological survey protocol (Kázmér, 2018).

3.1. Rotated capital

A column capital in the narthex (the western forecourt) of the church displays minor but significant counterclockwise rotation (Fig. 4). This kind of misalignment of construction elements, whose edges are supposed to be parallel, is clear evidence of lateral loading, caused by earthquakes (Hinzen et al., 2013; Cucci & Tertulliani, 2013; Hinzen, 2019).



Fig. 4 - Capital of a column in the narthex (forecourt), slightly rotated counterclockwise. The misfit caused by rotation between capital and plinth is encircled. Courtesy of A. Grynaeus.

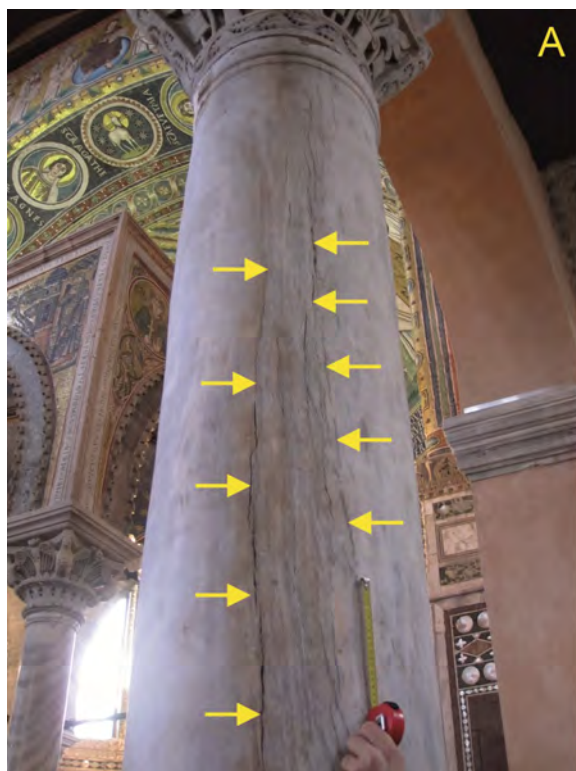


Fig. 5 - Axis-parallel fractures in a marble column. **A.** Fractures follow schistosity, a zone of weakness. Measure tape extended to 20 cm. ADB photo #2221. **B.** Fracture not following schistosity. Vertical extent of damage is ca. 1.2 m long. The separated portion of the top 30 cm was reattached during the Medieval restoration, while the remaining portion was replaced with cement. ADB photo #0085.



Fig. 6 - Fractured capitals, pillars, and plinths. Fracture planes are vertical, parallel with the axis of the columns, indicating the dominance of vertical shaking. A. Fully developed adjacent fracture both in the pillar and the capital. Pillar F, capital. ADB photo #0080. B. Two, conjugate joints enclose a slice of marble. If this fracture had developed further, a thin flake of stone would have been removed from the capital (see the similar feature demonstrated by Ambraseys & Psycharis, 2012, their fig. 8(b)). Pillar N, capital. ADB photo #0082. C. Broken-off corner of a pillar. An adjacent fracture marks the place where a second break-off might initiate. Pillar A, plinth. ADB photo #0076. D. Initial fracture, bordered by conjugate joints. Pillar O, plinth. ADB photo #0087. E. Broken-off splinter replaced by marble. Note the misfit of the column and the plinth: the column is narrower. Pillar I, plinth. ADB photo #0081. F. Missing splinter, repaired by concrete. Note the misfit of the column and the plinth: the column is wider. Pillar N, plinth. ADB photo #0086.

3.2. Fractured columns

Columns supporting the nave of the Euphrasius Cathedral were made of Proconnesian marble, sourced from the island of Proconnesos (today Marmara) in the Marmara Sea (Terry, 1988, p. 27). The texture of this stone displays alternating dark and light parallel streaks, which are parts of large, tight folds. This inhomogeneity makes the stone prone to jointing along these planes of schistosity (Fig. 5) (Attanasio et al., 2008). Therefore, fractures parallel to schistosity were omitted from the analysis of fracturing below.

The Proconnesian columns are characterized by a

broad, slightly rounded molding at the tip and a wide, flat molding that projects at the base. They are approximately uniform in height, ranging from 3.39 to 3.58 m. Circumference at the base of the shafts varies from 1.52 to 1.77 m. Many of the columns are something of an ill fit for their bases. Eleven columns rest on their bases, with 1.5-3 cm gap all around the column (Figs 6E, F) (Terry, 1988: 27-28). All these indicate that the columns were not purposely quarried on Proconnesos, but bought from a stone merchant, probably in Ravenna in Italy.

A number of columns are damaged (Fig. 6A-D).

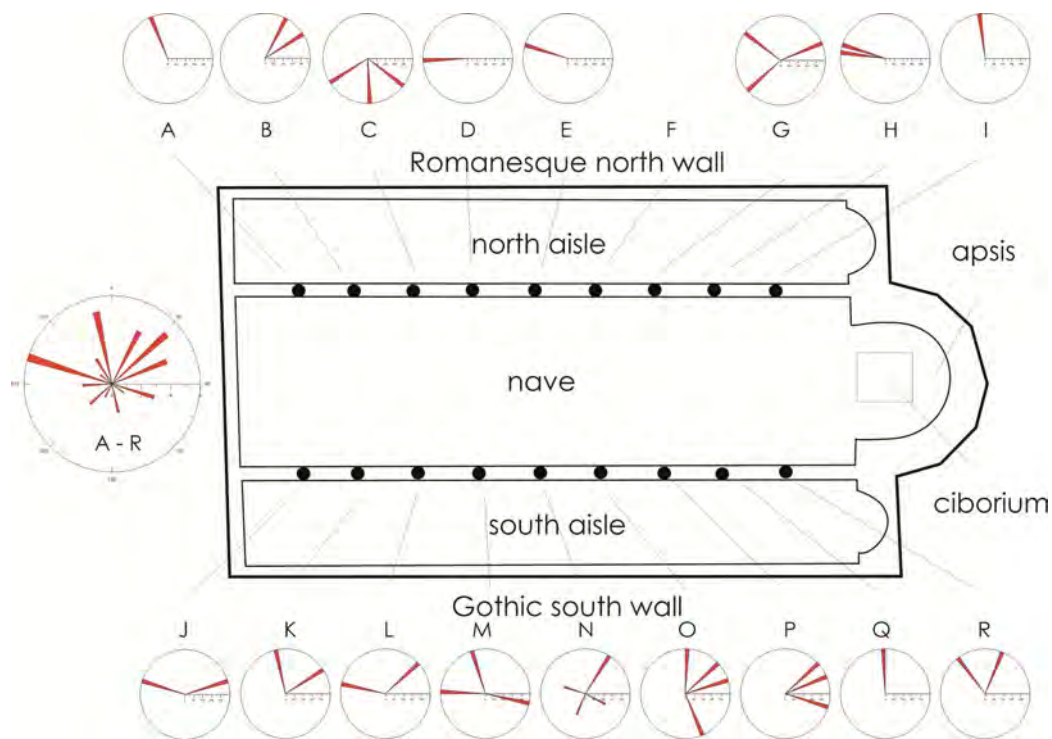


Fig. 7 - Floor plan (after Prelog, 1986, modified) with azimuths of chipping directions as observed on pillars. A composite rose diagram of all directions is shown on the left. Most directions are northward, both on the northern and the southern row. Another prominent direction is parallel with the church axis. Although this would mean N-S strong motion, it is not necessarily the case: north-south is the easiest way of free vibration here, perpendicular to the main axis of the cathedral. Northern row F: no chipping of pillars. For data used to produce this figure, see Table S1.

Terry (1988, footnote 71) provided a succinct verbal description of deformation features. We add dimensions (height and width of broken parts) and azimuth towards which the broken surfaces are directed (Fig. 7 and Table S1). Others columns bear markings of one kind or another, revealing former subsidiary functions during the reconstructions of the church throughout the centuries.

Chipped block corners are illustrated by Marco (2008: 151, his fig. 21) as markers of earthquake shaking. To distinguish these from 'normal' wear, Marco suggests that when chipping crosses bedding planes, joints, and fractures, it can be considered an earthquake-related deformation. These features are identical to the dipping, broken corners in masonry blocks of Rodríguez-Pascua et al. (2011, their Fig. 11A).

3.3. Deformed walls

Walls and columns display minute deviations from the vertical. The triumphal arch, separating the apse from the nave, and the walls of the nave deviate from the vertical. Both walls and columns are tilted outwards (Fig. 8). Most conspicuous is the north wall of the choir: it is visibly tilted outwards, especially when compared to the vertical edge of the ciborium (Fig. 8B).

3.4. Collapsed wall

Collapsed walls *per se* are not visible in the Euphrasius Cathedral. We can only infer that certain walls or portions of a building collapsed during an earthquake from certain unusual or mismatched architectural features.

The walls of the cathedral date back to the 6th century. The northern wall has nine windows with round arches (Romanesque style), while the southern wall has only five pointed-arch windows (Gothic style) (Fig. 3). Additionally, the stucco relief work on the intrads of the

southern wall is missing, while it is preserved on the northern wall (Sonje, 1967; Matejčić, 2014, p. 149). These differences suggest that the southern wall was severely damaged, possibly destroyed, demolished, and subsequently rebuilt. The top part, with the windows, certainly collapsed, while the lower part, near the marble columns, was severely fractured and fissured, and much of the stucco relief fell to the ground. Reconstruction between 1440 and 1461 rebuilt the wall up to the roof, inserted fewer windows, and did not replace the lost stucco.

4. DISCUSSION

4.1. Evidence for earthquake

Deformation of walls that were built on solid bedrock is most likely seismogenetic in origin (Marco, 2008, p. 152). The old town of Parentium was built on well-bedded Jurassic limestone, outcropping at places around the peninsula. This compact, hard rock, layered horizontally, provided a solid foundation for all buildings for two millennia; therefore we consider a seismogenetic origin plausible.

We apply the following practice to distinguish joints and fractures caused by seismic shaking from those caused by uneven loading of the superstructure. The basis of the distinction is that seismic shaking is a rapid process, whereas uneven loading is a slow process (Hinzen, 2019). Therefore, slow fracturing is more prone to follow the preset directions of textural weakness, such as bedding and schistosity, whereas rapid seismic fracturing tends to form fractures that deviate from these pre-set textural weaknesses. In our case, fractures following planes of textural weakness have been excluded from the analysis. A comprehensive treatment of the behavior of rocking columns, including modeling,

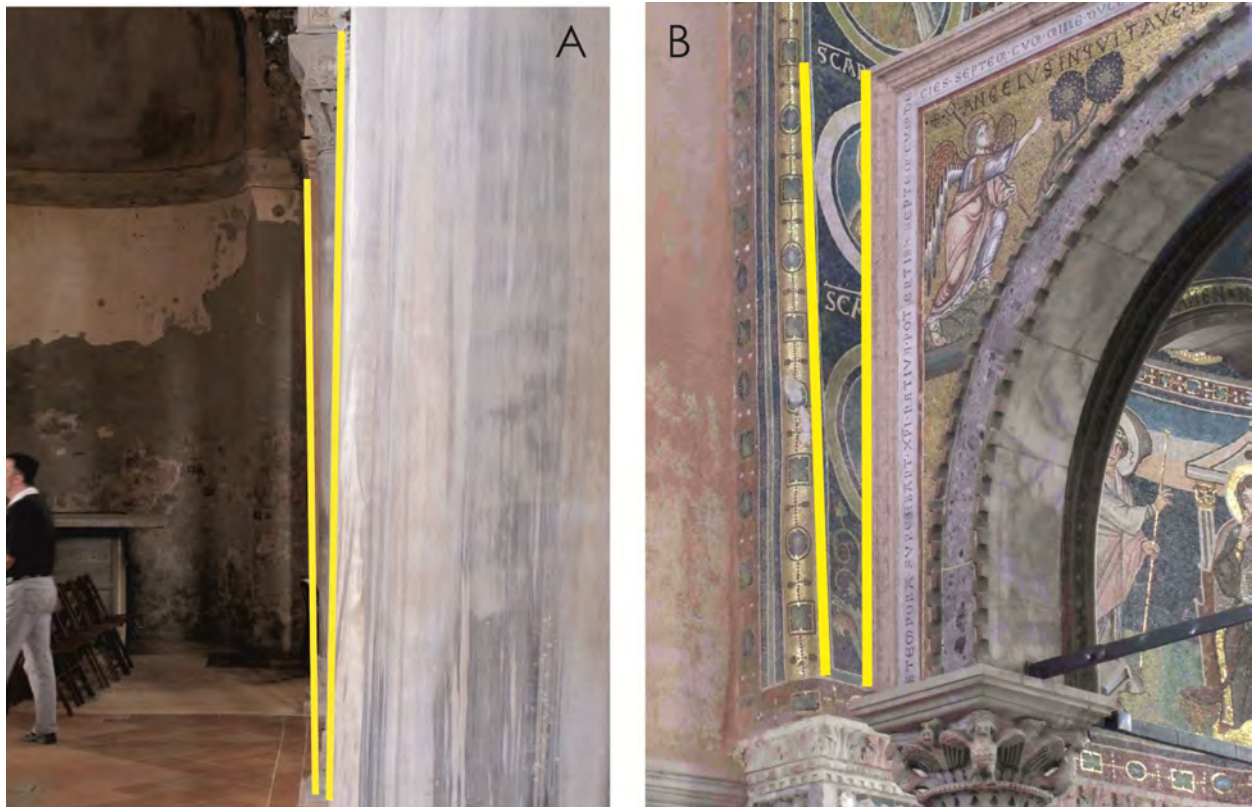


Fig. 8 - Column and apse wall deviating from vertical, tilted northward. A. Vertical pillar G in the foreground, vertical pillar H behind, northward tilted pillar I in the background. ADB photo #104_0095. B. NW corner of the ciborium is vertical (yellow line on the right), while the northern semi-pillar of the triumphal arch is tilted to the north (yellow line on the left). ADB photo #104_0092.

has been provided by Hinzen (2009).

Two types of fractures are distinguished: (1) oblique fractures, where the fracture plane is $30\text{--}45^\circ$ to the surface. These are essentially equivalent to Marco's (2008) chipped corners and Rodriguez-Pascua's (2011, 2022) dipping broken corners. Here, fracturing can be caused by both seismic shaking and uneven loading, as well as inadvertent hits during construction and the movement of furniture. (2) Axial fractures are most certainly caused by vertical hammering by the superstructure (Kázmér, 2021) (Fig. 6).

Applying computer models to understand the cracking process revealed that vertical, axial fracturing of columns is made possible by vertical seismic loading (Besharatinezhad et al., 2020). Axial cracking is produced by repeated vertical loading, while chipped corners are produced by tilting and rocking of the columns.

The deformation features described and illustrated above have close analogues in the seismically active Mediterranean region. We compiled examples of analogous damage features that have been reliably attributed to earthquake effects (Supplementary Table S2). These examples provide comparative support for interpreting earthquake damage features documented in the Euphrasius Cathedral.

Beyond these similarities, one has to consider whether a set of genuine damage features may be interpreted as the result of a single, well-defined seismic event, or whether other processes should also be considered. Differential settlement can be excluded: the church, as all the town, is built on thick-bedded, solid Jurassic limestone. Cumulative structural degradation, if it occurred, was probably corrected by invasive restoration phases, now concealed by plastering.

A major earthquake that affected Poreč probably affected the region beyond the town walls. Dropped voussoirs were mentioned in the arch of the Porta Aurea in Pula, 45 km to the southeast (Kázmér, 2013). Further deformations attributable to earthquakes are being identified in the city: the Roman amphitheatre, Porta Gemina, Forum of Augustus, and the Roman city walls. Damage to these sites remains undated within the past two millennia. Archaeoseismic studies of Medieval towns on the Adriatic islands, as far south as Zadar, revealed several damaged churches and secular buildings (Kázmér & Moro, 2018).

4.2. Earthquake parameters

No earthquakes are listed for the year 1440 or immediately preceding years that in the major catalogues known to us (Alexandre, 1990; Herak et al., 1998; Ambraseys, 2009; Markušić et al., 2016; Guidoboni et al., 2018, 2019; Alexandre & Alexandre-Lamotte, 2024). However, there is one indirect historical reference which has survived:

In Italian: *Nel 1440 per le scosse d' un terremoto crollò la navata destra della basilica Ano alle colonne; ma in breve fu rifatta, e 1°8 maggio 1461 la cattedrale veniva solennemente riconsacrata* (Babudri, 1913, p. 129).

In English: In 1440, the right nave of the Basilica of Ano alle Colonne collapsed due to the tremors of an earthquake, but it was quickly rebuilt, and on May 8, 1461, the cathedral was solemnly reconsecrated.

Unfortunately, Babudri (1913) did not provide the exact location of his source. Subsequent attempts to locate it have failed: the lost archives of Parenzo may be stored somewhere in Italy (Vatican, Venice) or in the

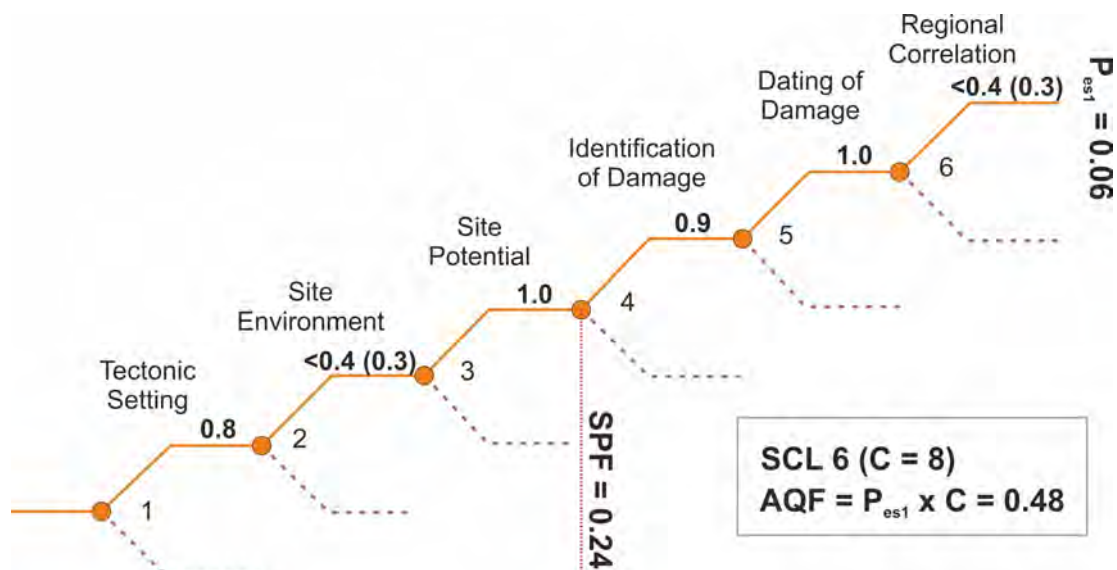


Fig. 9 - The logic tree for archaeoseismology (based on Sintubin & Stewart, 2008) applied to Euphrasius Cathedral in Poreč: SPF – Site Potential Factor, P_{es1} – preferred end solution, SCL – Site Confidence Level, AQF – Archaeoseismic Quality Factor. For a detailed description of each item used to calculate the AQF, see Table 1.

archives of the former Yugoslavia (Zagreb or Belgrade). We still consider this information valuable, attesting to the possibility of destructive earthquakes hitting Parenzo. We cannot be certain that the 1440 earthquake was responsible for the damage described here, we cannot be sure. But the minimal information provided in the historical text: „the right (i.e. the southern) nave collapsed” fits what the archaeoseismological survey found.

Intensity. The Earthquake Archaeological Effects (EAE-13) intensity scale, as proposed by Rodríguez-Pascua et al. (2013, 2016, 2022), assigns intensity VII and above to broken corners of blocks, and intensity IX and above to collapsed walls. The EAE scale is identical to the EMS scale, which is widely used in engineering seismology (Grünthal et al., 1998). We are aware that the latter was designed to describe damage on ‘normal’ buildings designed for everyday use; it is not suitable for characterizing singular, monumental buildings, such as the Euphrasius Cathedral. However, the structural and non-structural complexity of such buildings may lead to higher vulnerability than ordinary buildings despite being better built (Grünthal et al., 1998, p. 53). To remain on the side of caution, we suggest intensity VIII-IX for the 1440 earthquake.

Epicentre. Intensity VIII-IX of the 1440 earthquake suggests an epicentre along a causative fault within a few tens of kilometres of Poreč. Active faults are currently not known in Istria. Suspect active faults are the Buje thrust fault (20 km to the NE from Poreč; Placer et al., 2010), the fault splay between Buzet and Petrinje faults (35-50 km NE from Poreč; Atanackov et al., 2021).

An M 3.0 earthquake of strike-slip focal mechanism occurred north of Poreč, near the Buje thrust fault. There, the Buje fault displays minimal, 0.0-0.1 mm/yr right-lateral strike-slip faulting (Grützner et al., 2025, their Figs. 8 and 12). There was an M_L 4.1 earthquake in the Adriatic Sea, 16 km southwest of Poreč, in 2007, with a NW-SE strike-slip component. The hypocenter was at a depth of 18 km (Ivančić et al., 2018).

Additionally, the seismically active main zone of the Dinarides lie about 70 km northeast of Poreč and

beyond (Ivančić et al., 2018; Grützner et al., 2025, their fig. 15).

4.3. Implications for seismic hazard in Istria

Over the last two millennia, Poreč and the rest of the Istria peninsula has been a seemingly seismically quiet area. However, the lack of records does not mean the lack of earthquakes (e.g., Kázmér & Györi, 2020). The largest known earthquake near Poreč was in the Adriatic, an M 4.1 event offshore. However, earthquakes of magnitude greater than 6.0 occur frequently along the various faults of the Dinaric front, about 70-100 km to the northeast (Markušić & Herak, 1999).

Seismogenic zone maps of Croatia (Markušić & Herak, 1999) and Slovenia (Živčić et al., 2000) omit Istria from among the numbered seismogenic source zones, considering the peninsula aseismic. To assess the probability of past earthquakes based on historical and archaeoseismological data, we conducted a logic-tree study to express the level of certainty with which the Euphrasius site in Poreč has recorded a paleoearthquake (Sintubin & Stewart, 2008). The number measures the archaeoseismic quality factor (AQF), which reflects its relative significance in a seismic-hazard analysis.

Providing quantitative assessments of the archaeoseismological approach has the following key benefits: (1) The individual probabilities at each node highlight the relative weaknesses of the scientific argument for an earthquake origin. (2) The cumulative probability of the end solution establishes an overall estimation of the quality and appropriateness of the archaeoseismological evidence with respect to the seismic hypothesis. Evaluating the level of confidence in the archaeoseismological argument is critical if archaeological findings are to be incorporated into seismic-hazard studies. It quantifies the uncertainties related to an incomplete archaeological and geological dataset, ensuring the reliability of the results obtained (cf. Hinzen, 2005).

In the following, we apply the logic tree formalism of Sintubin and Stewart (2008), which provides a simple framework for organizing different interpretative stages and diverse scientific inputs into a standardized

Table nr. Sintubin & Stewart (2008)	Quality weight factor (QWF)	Value of parameters
Tectonic setting (Table 1)	0.8	Intermediate strain rates (≥ 0.1 mm/yr) Seismogenic fault known within a radius of 100 km Epicenter of major earthquake(s) ($M \geq 6$) known within radius of 100 km
Site environment (Table 2)	<0.4 (0.3)	No discernible seismic landscape No perceptible environmental effects
Site potential (Table 3)	1.0	High potential Stone building Ashlar Excellent quality of construction No ground instability Flat physiography Solid bedrock Long occupancy No anthropogenic disturbances Evidence of remodeling
Identification of damage (Table 4)	0.9	Most of the damage can be positively identified as caused by earthquakes
Dating of damage (Table 5)	1.0	Excellent historical record: earthquake described at the site from one contemporary account
Regional correlation (Table 6)	<0.4 (0.3)	No sites in the proximity of the site studied

Tab. 1 - Items used to calculate the archaeoseismic quality factor (based on Sintubin & Stewart, 2008).

archaeoseismological approach. The logic-tree method formalizes the approach to archaeoseismological investigations by adopting a standardized framework for interpreting geological and archaeoseismological data related to possible seismic influences on cultural sites. Here we apply it to retrospectively evaluate our archaeoseismological dataset, as demonstrated above.

The logic-tree analysis for the Euphrasius Cathedral in Poreč yielded a Site Potential Factor (SPF) of 0.24, indicating a moderate potential of the site to preserve archaeoseismological signatures through the first stages of the interpretative process (Fig. 9 and Table 1). The preferred end solution (P_{es1}), which represents the cumulative probability assigned to the most supported interpretation across all stages, and captures the overall uncertainty in linking the observed damage to specific palaeoearthquakes, was estimated at 0.06 - comparable to values reported by Sintubin and Stewart (2008) for the archaeological site of Sagalassos in southwest Turkey. When adjusted for a Site Confidence Level (SCL=6, C=8), the Archaeoseismic Quality Factor (AQF) was calculated as 0.48, reflecting a comparatively robust assemblage of evidence and reliability of the earthquake interpretation under the logic-tree framework.

5. CONCLUSIONS

The Istria Peninsula, located in the northern Adriatic Sea (bordering Croatia and Slovenia), has been considered a nearly aseismic part of the Adriatic microplate, in contrast to the seismically active frontal ranges of the Dinaric orogen. We present new archaeoseismological data from the Medieval Euphrasius Cathedral in Poreč, including rotated masonry, various fractures in monolithic marble columns, tilted columns and walls, and a collapsed wall of the nave. Fractures in columns display a northward azimuth, indicating predominantly north-south shaking of the building during the earthquake. We attribute these features to an intensity = VIII-IX earthquake in 1440 AD.

Set in the context of regional seismicity and tectonic activity, the Istria peninsula cannot be omitted from regional seismic zoning studies.

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