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Defensive Walls of Chersonesos Taurica. An Analysis of Destruction and Reconstruction Traces

Introduction

Reasons of destruction of architectural substance in ancient cities and towns are often discussed as research subjects. Destructions could be caused both by natural factors as well as by the activity of man.

Sieges, although often well-known, usually did not cause extensive destructions of fortifications, which would be identifiable until today for archaeologists and architects. Moreover, it seems that damage caused by siege engines available in Antiquity should be of punctual nature, and fissures should go radially in relation to the point of application of force. Such conclusions may be drawn among others from the analysis of kinds of siege engines which were in use (Vitr. *De Arch*. 10. 10–15).

Such evident and unambiguous archaeological evidence of siege activities as traces of fights in a sap under one of turrets at Dura Europos is also rare (James 2004: 38). Much more extensive and better legible destructions are left by catastrophes related to endogenous geological processes. Best known are of course entire archaeological sites where the life was extinguished by eruptions of volcanoes, as it is the case at Santorini, Pompeii or Herculaneum. Layers of sand and silt which are remains of tsunami waves, which hit various parts of the coast of the Mediterranean Sea in the past, are sometimes also easily identifiable (i.a.: Luque et al. 2002; Salamon et al. 2007; Scheffers, Scheffers 2007). A vast majority of territories on the Mediterranean Sea and the Black Sea are zones of considerable seismic activity. Small quakes are everyday matter, while strong (devastating) earthquakes occur in the majority of mentioned territories every some dozen or several hundred years. Traces of seismic activity which were recorded in written and archaeological sources have already been discussed in a number of publications (i.a.: Ambraseys 1994; 2005; 2006; Goodchild 1966–1967; Haynes, Niemi, Atallah 2006; Jaworski 2009; Marco 2008; Russell 1980; 1985; Suleiman, Albini, Migliavacca 2004), including a major work in the form of a catalogue (Guidoboni et al. 1994). In the light of this data, Crimea (ancient Taurica) seems to be an extremely poorly investigated area.

It is surprising, especially bearing in mind that the southern part of the peninsula with the Crimean Mountains still demonstrates seismic activity. Traces of destructions which may have resulted from an earthquake and which were recorded in the course of excavations were a subject of few publications, mainly dealing with the territory of the Kerch Peninsula. Excavations during which probable traces of an earthquake were observed were carried out at sites possibly related to Bosporan settlement (Tolstikov 1999; Vinokurov, Nikonov 1998; 2004). Results of the mentioned works contributed to establishing a chronology of ancient earthquakes from 3rd c. BC, 1st c. BC and 3rd c. AD; on the other hand, traces of destructions which could be related to seismic event from 1st c. BC (63 BC) were not found on the defensive walls of the Bosporan fortress of Kutlak (to the west of Sudak). This is the most important argument suggesting that the fort was constructed after the mentioned date (Lancov 1997: 70; 1999: 123).

Archaeological research at Chersonesos and in its *chora* has a very long history. However, it yielded only a few publications devoted to seismic destructions legible in the town and in neighbouring farms. Traces of earthquakes were mentioned by I.A. Antonova, who invited a seismologist V. Nikonov to participate in her research (Antonova 1996: 119; 1999; Antonova, Nikonov 2009). Nikonov mentioned fissures notable in some parts of defensive walls of Chersonesos (which are traces of earthquakes) and recorded damage of this kind, among others, in lower parts of Curtain 19, in the so-called "core" of Turret XVII and in remains of a gate in Curtain 16 (Antonova, Nikonov 2009: 18, 20).

Research methods

The research for traces of earthquakes on the defensive walls of Chersonesos Taurica was started with making of photographic and drawing documentation of remains which were accessible on the surface of the ground. Already at this stage it was possible to confirm the presence of numerous fissures. This documentation was then compared with available parallels from other seismic areas.

The main part of fieldwork were measurements of fissures, carried out directly on the walls. During the research over 200 fissures were measured. The angle of deviation of fissures from the plane was measured with a geological compass. Due to technical reasons, it proved impossible to measure all the parameters of existing fissures. This was because the fissures were too narrow to make it possible to identify the dip of fissure. However, within the framework of the measurement project it was decided that this piece of information may be omitted, as the course of the defensive walls in relation to the north was identified.

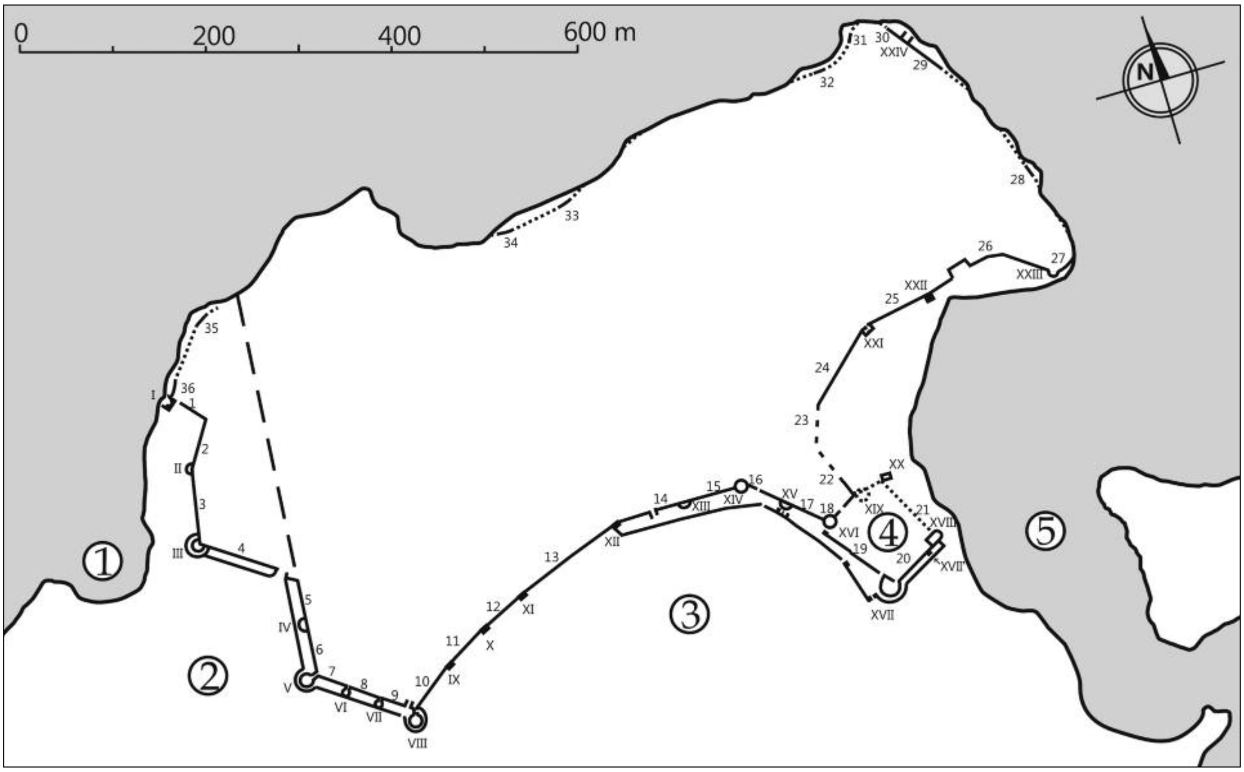

Fig. 1. Chersonesos Taurica. General plan. Curtains of town walls are marked with Arabic numerals and turrets are marked with Roman numerals (after: Bert'e-Delagard" 1907, drawing P. Zakrzewski). 1 – Pesočnaâ Buhta (Sandy Bay); 2 – Pesočnaâ Balka (Sandy Ravine); 3 – Karantinnaâ Balka (Quarantine Ravine); 4 – Citadel; 5 – Karantinnaâ Buhta (Quarantine Bay).

Рис. 1. Херсонес Таврический. Общий план. Арабскими цифрами обозначены куртины городских стен, а римскими цифрами –башни (по Бертье-Делагарду [Bert'e-Delagard"] 1907). 1 – Песочная бухта; 2 – Песочная балка; 3 – Карантинная балка; 4 – Городская цитадель; 5 – Карантинная бухта.

Ryc. 1. Chersonez Taurydzki. Plan ogólny. Cyframi arabskimi oznaczono kurtyny murów miejskich, a cyframi rzymskimi baszty (za: Bert'e-Delagard" 1907). 1 – Pesočnaâ Buhta (Zatoka Piaskowa); 2 – Pesočnaâ Balka (Jar Piaskowy); 3 – Karantinnaâ Balka (Jar Kwarantann); 4 – Cytadela miejska; 5 – Karantinnaâ Buhta (Zatoka Kwarantann).

Only blocks of the face within accessible parts of the defensive walls underwent measurements. These were faces of Curtains 16, 17 and 19, with Turrets XV, XVI and XVII, as well as with a wicket in Curtain 19, which led to the area of the citadel (**Fig. 1**).

The next stage was an analysis of acquired results. For this purpose, measurements which were done for individual curtains were put together. Rosette diagrams were chosen as a form of presentation, from which the most frequently occurring values of angles can be easily read (**Figs. 2–4**). This kind of graph shows the frequencies of occurrence of the fissures of the same angle. Rosette diagrams are built on a basis of circle, and each fissure of the same 5 degree interval is shown as one unit in its direction. The authors of the present paper chose the mentioned methods due to their simplicity and a quick pace of taking measurements. At the same time it must be underlined that the chosen way of analysis is not free of shortcomings. Walls, as opposed to rocks, are made from blocks, and this may cause various deviations from expected responses to a given destructive impulse. An assessment of the reaction of the geological substratum for seismic waves is an additional difficulty.

Transformations and destructions within the defensive walls

Surviving vestiges of the walls are a very complex structure. They include remains of a number of curtains and turrets, and each of these shows traces of various building phases. Architectural remains which have survived until now are situated mainly in the south-eastern part of the fortifications of the town. In the course of centuries, curtains and turrets were rebuilt and extended in two different ways. Some of these were provided with superstructures for many times and thus remains of subsequent phases are situated one above the other. This phenomenon can be seen in the case of Curtains 16, 17 and partially 19, as well as in Turret XVI. Providing this part of the defences with superstructures was a well-considered solution and was related to a steady accumulation of sediments in the foreground of the fortifications. The reason behind this phenomenon was a periodical flow of water in the bottom of a nearby ravine (cf. Karasiewicz-Szczypiorski 2014 – this volume, 87–112). The mentioned part of the walls crossed the mouth of Quarantine Ravine (Karantinnaâ Balka) to the bay of the same name (**Fig. 1**).

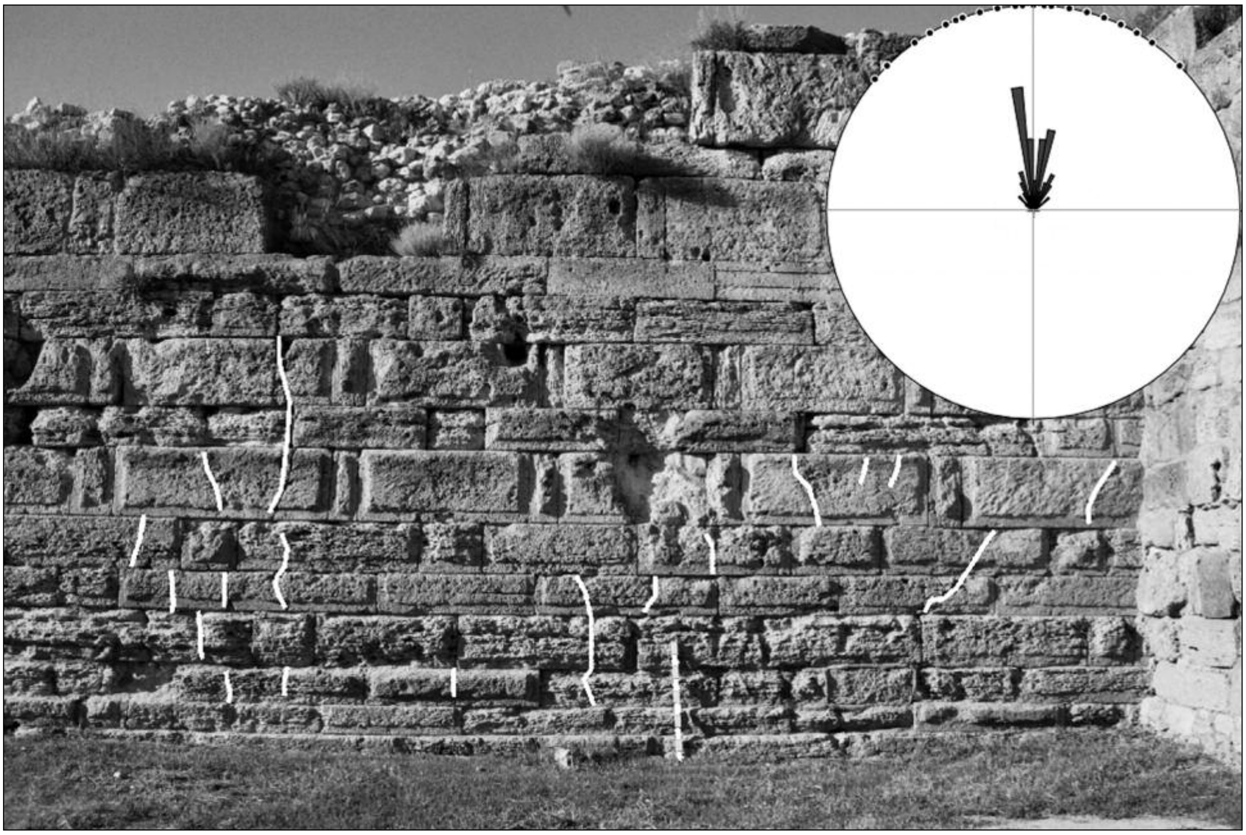

Fig. 2. Part of Curtain 16 adjoining Turret XV with a directional graph of fissures for the entire Curtain 16 (Photo and processing U. Zawadzka-Pawlewska).

Рис. 2. Участок куртины 16 прилегающий к башне XV, вид с прорисовкой направления трещин по всей стене 16.

Ryc. 2. Odcinek kurtyny 16 przylegający do baszty XV wraz z wykresem kierunkowym spękań dla całej kurtyny 16.

Turret XVII and Curtain 20, situated slightly higher on a slope, were changed in a different manner. They were modernised by constructing new or additional structures outside previous fortifications. In the case of Curtain 20, part of earlier defensive walls was then dismantled, while in the case of Turret XVII extensions consist of three subsequent thickenings of the round structure. It is worth mentioning that fortifications on the side of the Quarantine Bay (Karantinnaâ Buhta) developed in a yet another way. It seems that the shore line gradually moved away from the fortifications, which was related to silting of the littoral part of the water front. This process necessitated a construction of new fortifications outside earlier walls in order to protect the nearby port on the side of the land. In this way additional terrain was gradually included within the fortifications. Similar rebuildings were probably carried out for several times and they are best identified and discussed based on the example of the fortifications of the citadel (Karasiewicz-Szczypiorski 2001; 2014).

A very important factor which allows for a better understanding of reasons why we have to do with such big differences in the state of preservation of the walls in individual parts of the fortifications, as well as with traces of their important repairs, is the founding of the curtains and turrets. Foundations of the walls along the Sevastopol Bay (Sevastopol'skaâ Buhta), as well as the farther course of the fortifications on the west and the south (from Turret I almost to Turret XIV) reached shallowly deposited rock. Such a solution, as the most appropriate one, was recommended to ancient builders by, among others, Vitruvius (Vitr. De Arch. 1. 5. 2.). This way of founding can be seen in a considerable part of the fortifications of Chersonesos on the side of the land (from Turret VIII to Turret XII, and partially also farther off to Turret XIV). The farther part of the fortifications was built across the mouth of Quarantine Ravine (cf. Bert'e-Delagard" 1907: 124–125). Excavations and drills demonstrate that at least in a part which is closer to the axis of the mentioned ravine the foundations did not reach any stable substratum (Antonova 1996: 103–105, 116). Berthier de Lagarde suggested that the terrain for the construction of the fortifications and the port was acquired by means of filling up the shallower part of the bay in the mouth of Quarantine Ravine (Bert'e-Delagard" 1907: 124–125). This does not seem probable. On the other hand, results of archaeological research demonstrate that the ground for the fortifications in the discussed part was stabilised by means of creating a sort of substruction from gravel and sand. A layer

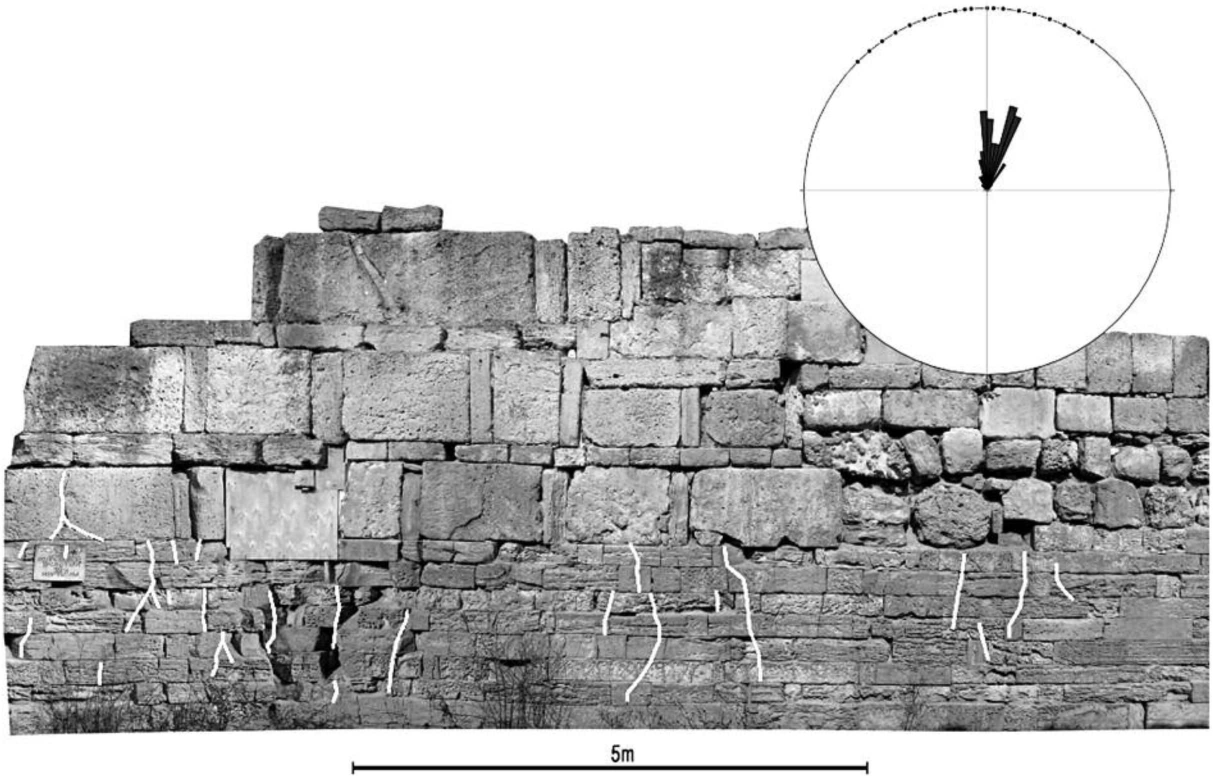

Fig. 3. Part of Curtain 19 with a directional graph of fissures (Photo R. Horosz, processing U. Zawadzka-Pawlewska).
Рис. 3. Участок стены 19, вид с прорисовкой направления трещин.
Ryc. 3. Odcinek kurtyny 19 wraz z wykresem kierunkowym spękań.

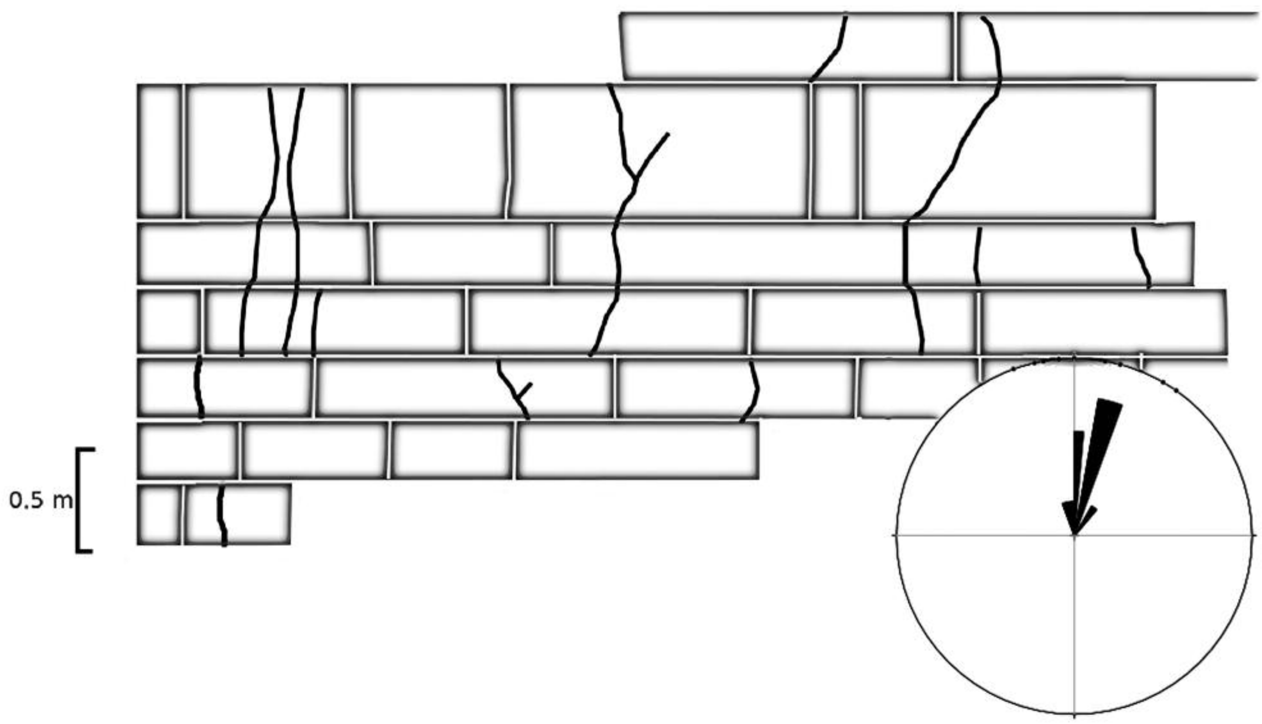

Fig. 4. Western pylon of the gate in Curtain 16 with a directional graph of fissures (Drawing U. Zawadzka-Pawlewska).
Рис. 4. Западный пилон ворот в куртине 16, вид с прорисовкой направления трещин.
Ryc. 4. Pylon zachodni bramy w kurtynie 16 wraz z wykresem kierunkowym spękań.

of a similar composition cannot be found in other parts of Quarantine Ravine (Antonova 1996: 107–108). In the case of the discussed fortifications there is no information on piling of the terrain, which would seem to be a justified procedure, bearing in mind shallow ground waters and closeness to the sea. Such a solution was described by Vitruvius (Vitr. *De Arch*. 3. 4. 2.). In the discussed part of the fortifications piling is mentioned by Berthier de Lagarde. However, this mention concerns Late Byzantine building phases in Turrets XV and XV' and is very general (Bert'e-Delagard" 1907: 125). It seems that piling was indispensable while building the walls of Roman phases of Curtain 21 and nearby turrets, which constituted the fortifications of the citadel on the side of the Quarantine Bay. This assumption, however, has not been hitherto verified. Due to a high level of ground waters in the discussed part, no researcher was able to reach a sufficient depth with excavation trenches.

Interpretation and chronology

Geology and tectonics of the Crimean Peninsula (Fig. 5)

Chersonesos Taurica is situated within the borders of the present-day city of Sevastopol on the south-western edge of the Crimean Peninsula. This part of Crimea is traditionally called the Heraclean Peninsula. This area is separated from the rest of Crimea with two bays – the Sevastopol Bay on the north and the Balaklava Bay on the east. A cuesta prominence of the Sapun Ridge (Sapun gora) constitutes the land frontier. Both geology and the land relief in this area are extremely complex and they are a testimony of forceful geological transformations. A dominant land relief in the Heraclean Peninsula is the top surface of the cuesta hill, inclined to the north-west and cut with valleys of tectonic origin (Bosak, Nekovarik, Zelenka 1976; Florinsky 1996; Panek et al. 2008: 451–453).

The area which is occupied by the ancient town is situated in the borderland of two zones of different height above sea level. The eastern part of the town is situated in the mouth of Quarantine Ravine, which is one of tectonic splits. The western part of the town is mainly situated on an elevation which is a continuation of the top surface of the cuesta hill.

In terms of geology, the Crimean Peninsula is situated on the border line of two large tectonic units: the Black Sea microplate and the Eurasian Plate. The most noticeable effect of geological activity in the touch line of these units are the Crimean Mountains – a corrugated mountainous region from the Alpine Orogeny (Balassanian 1997: 2, 6).

The unit on the south is a plate of the oceanic type (Besutiu, Zugravescu 2004: 4). On the north there is a vast continental plate which is remarkable for its extraordinary stability. The border between these units was formed in the shape of a reverse fault, which should be interpreted as a result of a movement of the oceanic plate under the continental plate. Shifts of the oceanic plate are caused by a pressure of the Arabic Plate towards the north. Tensions which come into existence in result of this movement spread in three directions. Two of these (stronger ones) are the Caucasian and the Anatolian directions. Part of the force, however, is relaxed by the Black Sea plate (Cisternas, Philip 1997: 64–67). This process causes earthquakes in the southern part of the Crimean Peninsula. Movements in this area have less energy and are less frequent than other movements in this region. However, they are noticeable and cause local destructions (e.g., Karnik 1968).

Southern Crimea is surrounded by three main zones of occurrence of earthquakes:

- Yalta-Alushta: this is the zone of the strongest earthquakes in Crimea. Two such earthquakes with a magnitude exceeding 6 degrees are known: from 1869 and 1927 (Neprochnov, Ross 1978: 1053);
- Sevastopol;
- Sudak and Feodosia.

An additional aspect related to the seismicity of the territory of the Crimean Peninsula are numerous active faults, with a movement not exceeding 5 mm/year (Trifonov 1997: 172–173, fig. 1). Places of this type are remarkable, among others, for increased activity and concentration of landslides. The latter were also noticed in the area of valleys surrounding the Heraclean Peninsula from the east. In the entire territory of the Crimean Mountains one of Europe's larger concentrations of such formations was identified (Panek et al. 2008: 469–471). The mentioned publication also gives the dating of the most significant seismic episodes. These pieces of information complete an earlier work of Nikonov (Nikonov 1995: 52–54). Published data indicate that the strongest earthquakes in the past can be dated to the 1st c. BC and the 3rd c. AD. In later publications Antonova and Nikonov also mention earthquakes in the end of the 1st c. AD, in 487 and in the first half of the 11th c. (Antonova 1999; Antonova, Nikonov 2009). It seems that the entire area in the northern foregrounds of the Crimean Mountains was subject to simultaneous quakes. However, their strength and results may have varied a bit. These depended i.a. on the distance from the epicentre and the geological structure in a given location.

Examples of seismic destructions – analogies taken into consideration for the analysis

Surviving remains of the defensive walls of Chersonesos bear traces of numerous damages which may be classified as seismic destructions. The most evident examples with regard to that are provided by Curtains 16 (**Fig. 2**) and 19 (**Fig. 3**), as well as the western pylon in the gate in Curtain 16 (**Fig. 4**) (cf. Antonova, Nikonov 2009: 18, 20).

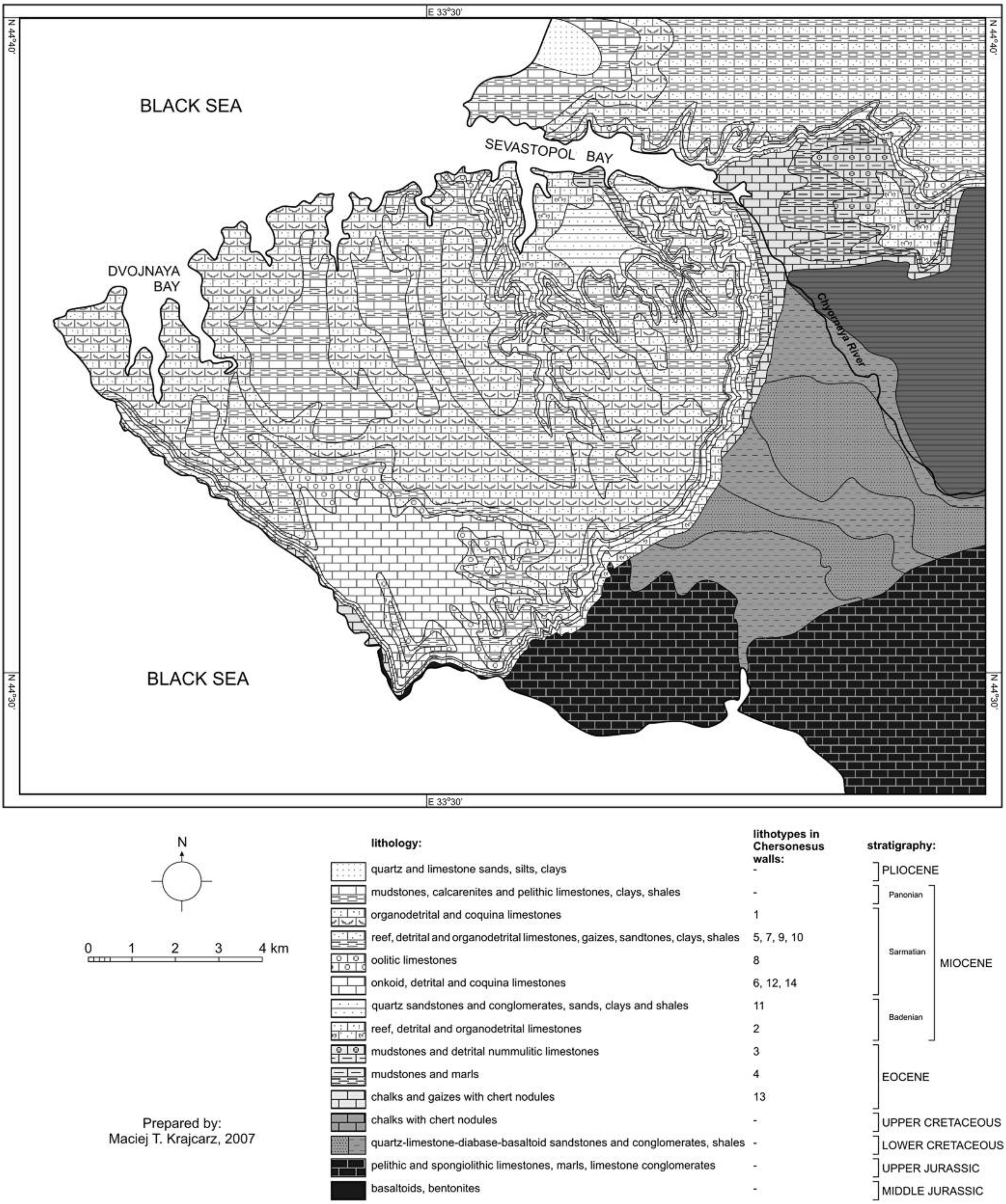

Fig. 5. Geological map of the Heraclean Peninsula, without Quaternary (M. Krajcarz; for description of lithotypes 1–14 cf. Karasiewicz-Szczypiorski 2014 – this volume, 89–98).

Рис. 5. Геологическая карта Гераклейского полуострова, без четвертичного периода.

Ryc. 5. Mapa geologiczna Półwyspu Heraklejskiego, bez czwartorzędu.

An analysis of analogies of various kinds was helpful in the identification of reasons of fissures in the walls of Chersonesos. Both results of experimental research and documented examples of present-day destructions were taken into consideration. Furthermore, the analysis also included data on supposed seismic destructions dated to the Hellenistic and Roman Periods known from archaeological sites in the vicinity of Chersonesos (cf. Antonova, Nikonov 2009: 22–23).

So far, examinations of the impact of seismic quakes have been carried out i.a. on a model of St Nicetas Orthodox Church in Banjani in Macedonia (Gavrilovic, Zelenkovska 1995). On the other hand, in Bulgaria an analysis of seismic destructions in existing architectural substance was carried out (Christoskov et al. 1995: 910). Results of the mentioned investigations allowed to relate the following types of deformations to earthquakes:

- protrusion of stones out of the face of the wall,
- sliding apart of fissures between stones in spots of already existing fractures,
- conical-shaped fractures,
- horizontal shifts of blocks,
- turns of blocks,
- fissures caused by impact,
- spalling of voussoirs.

Destructions which can be seen in the defensive walls of Chersonesos are similar to the aforementioned examples from Macedonia and Bulgaria. This is especially well-visible in the case of fissures. Rosette diagrams which are an element of interpretation of measurements of fractures in masonry walls demonstrate that the course of fissures is similar to that which was caused by earthquakes in other territories (**Figs. 2–4**; Dadlez, Jaroszewski 1994).

Traces of destructions which are probably related to an earthquake were legible beyond Chersonesos in the ruins of the Temple of Jupiter Dolichenus in Balaklava (**Fig. 6**). In the course of investigations it was possible to record a clear deviation from the vertical of the longitudinal Wall 1. This wall originally bore part of the weight of the roof. The wall deviated to outside, that is, to the south-west, and in this case it must have separated from the longitudinal south-eastern wall of the temple (Wall 4). The mentioned wall and the longitudinal load-bearing wall (Wall 6) bear traces of repair. Places of repair were clearly visible, as subsidence in the masonry wall was filled with another kind of stone, which was not used previously. Originally, the walls were built from pieces of local sandstone cemented with calcite. These pieces were formed into flat plates. For repairs, blocks of other local rock were used – it was Balaklava metamorphic limestone. However, in the publication of results of research on the Temple of Jupiter Dolichenus, an earthquake was not taken into consideration as a possible reason for the observed destructions. The reason for the deviation of the load-bearing Wall 1 was defined as "the weight of the ruins and layers which were forming" (Sarnowski, Savelja 2000: 57). The authors of the present paper believe that these suggested reasons do not seem sufficient. The accumulation of layers should rather cause forces acting evenly in various directions. Furthermore, these forces should be counterbalanced by the accumulation of layers outside the collapsed building. Traces of destructions which are noticeable at the site indicate that the impact of the forces was very uneven. Wall 1 deviated to outside and probably pulled the structure of the roof with itself. Due to this, damage was done to the opposite load-bearing Wall 6. The deviating Wall 1 must have broken off from the transverse Wall 4. Perhaps a fissure also occurred in the interface of Walls 1 and 5 (the wall with an apse). Regrettably, the corner of the temple did not survive.

Traces of repairs of the masonry wall of the another building at Balaklava – the so-called "barracks", later identified as the *praetorium* – may be a testimony of removal of results of this cataclysm. The mentioned building was ranked to the same building phase as the Temple of Jupiter. The (southern) wall of the mentioned building was dismantled nearly to its foundation footing and then it was recostructed (**Fig. 7**). This is only one of elements constituting the image of an extensive rebuilding of the *Praetorium* at the beginning of the 3rd c. AD (Karasiewicz-Szczypiorski, Savelâ 2011: 174; 2012: 175–176, figs. 1, 6; 2013: 127–131, figs. 7–12; 2014: 163–172). Perhaps this rebuilding resulted not only from the exchange of garrisons at the turn of the 2nd and 3rd c. AD, but was also forced by a need for repairing of destructions caused by an earthquake. Also at the site of Kazatskaya Hill poorly identifiable traces of destructions were recorded. These were remains of roofing tiles and pieces of charcoal, which were trodden into the floor inside the watchtower (Wróbel, Piątkowska-Małecka, Karasiewicz-Szczy-piorski 2012: 102, fig. 3:3). Also in a part of rooms which accompanied the tower and were built in the court-yard two usage levels are legible. These are separated with a layer of pure clay, which came into existence in all probability in result of the collapse of walls of the mentioned rooms. Of course, it is not possible to unequivocally say that an earthquake was responsible for the mentioned destructions.

A list and an analysis of remains of buildings in the citadel of Chersonesos from the Roman period show to the fact that two main building phases (Phase I and Phase II) were also separated with a horizon of destruction and a levelling layer (Karasiewicz-Szczypiorski 2001: 63–66). After Phase I, there was an evident one-time elevation of the usage level in most rooms. Part of buildings in Phase II did not repeat the earlier plan and partitions. In some cases there is perhaps also a change of the function of examined features. Scholars express different opinions on the chronology of these changes. Stratigraphic observations in the recent years in Balaklava-Kadykovka and earlier statements concerning the chronology and periodisation of the Roman military presence in Taurica point out that the horizon of destruction is to be most probably dated to the turn of the 2nd and

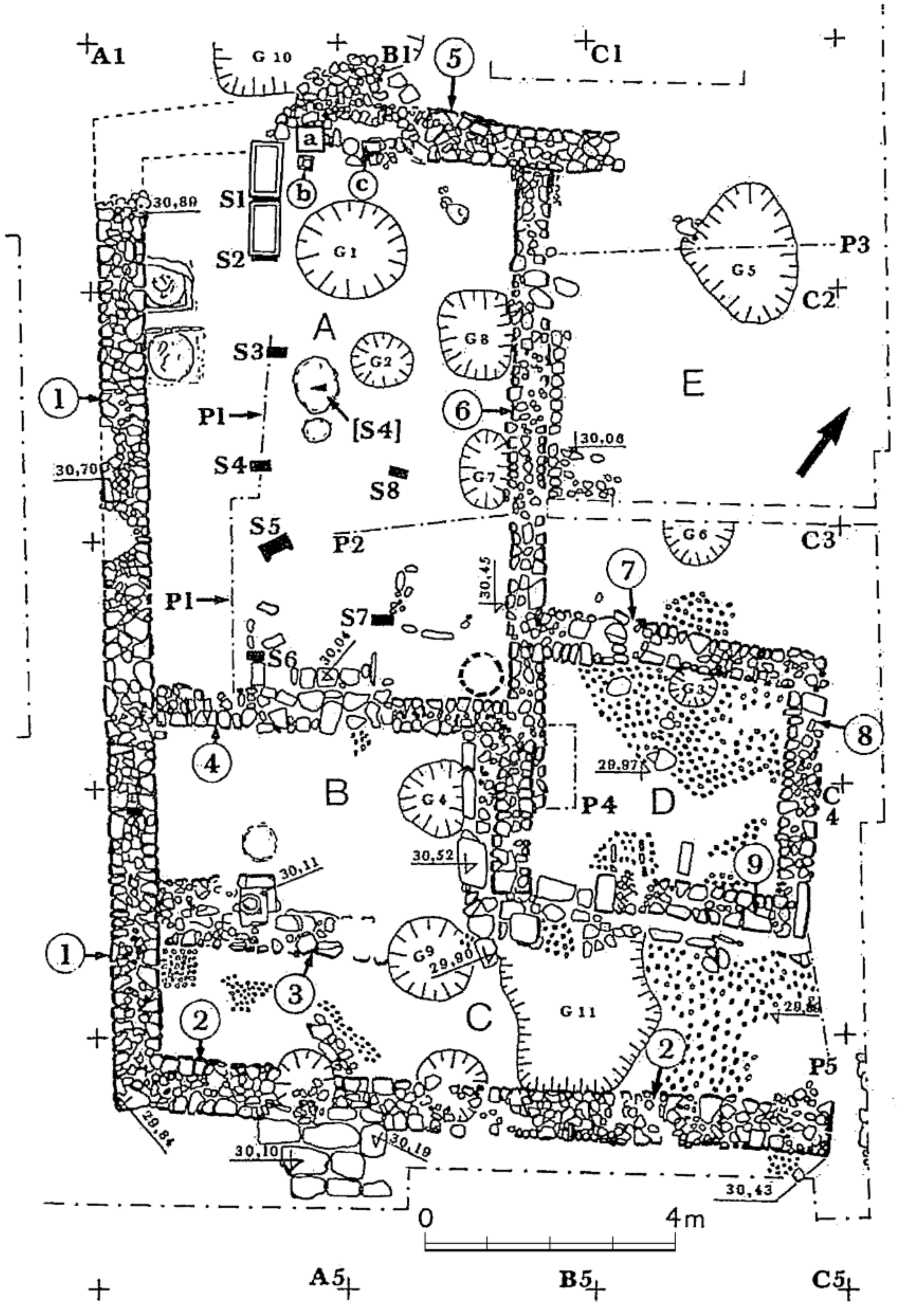

Fig. 6. Balaklava. Plan of the Temple of Jupiter Dolichenus (after Sarnowski, Savelja 2000: fig. 6).

Рис.6. Балаклава. План храма Юпитера Долихена.

Ryc. 6. Bałakława. Plan świątyni Jowisza Dolicheńskiego.

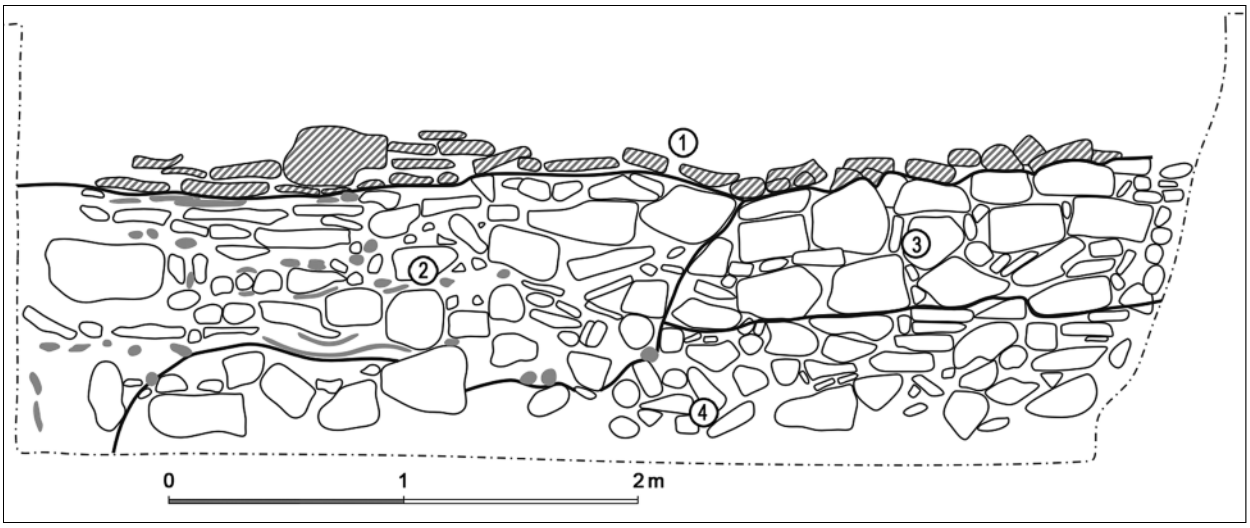

Fig. 7. Balaklava. Face of the rebuilt external foundation of the *Praetorium* (elaborated by R. Karasiewicz-Szczypiorski, drawing J. Kaniszewski). 1 – remains of the external wall at the level of the ground floor (Phase 3); 2–4 – foundation of the building (Phase 3): 2 – part of the foundation which came into existence during the construction of Phase 3, 3 – remains of the external wall at the level of the ground floor (Phase 2), 4 – remains of the foundation of the building (Phase 2).

Рис. 7. Балаклава. Вид внешнего, перестроенного фундамента Претория. 1 – остатки внешней стены здания (3 строительный период); 2–4 фундамент здания (3 строительный период): 2 – часть фундамента возникшего в 3 строительный период, 3 –остатки внешней стены здания (2 строительный период), 4 – остатки фундамента (2 строительный период).

Ryc. 7. Bałakława. Lico zewnętrznego, przebudowanego fundamentu Pretorium. 1 – pozostałości ściany zewnętrznej na poziomie parteru (faza 3); 2–4 – fundament budynku (faza 3): 2 – część fundamentu, która powstała podczas budowy fazy 3, 3 – pozostałości ściany zewnętrznej na poziomie parteru (faza 2), 4 – pozostałości fundamentu budynku (faza 2).

3rd c. or to the early 3rd c. (cf. Sarnowski 2005; Wróbel, Piątkowska-Małecka, Karasiewicz-Szczypiorski 2012: 102, figs. 2, 3; Karasiewicz-Szczypiorski, Savelâ 2011; 2012; 2013; 2014). Destructions in the citadel which are believed to have taken place after AD 225 are to be correlated with the horizon of destructions which are legible in other places of stationing of the Roman troops (Kazatskaya Hill, Balaklava-Kadykovka). They were perhaps also related to seismic activity, but they are first of all linked in time with the abandonment of garrisons in Crimea by *vexillationes* of the 11th Claudian legion at the end of the rule of the Severan dynasty (cf. Filippenko, Alekseenko 2000). Traces of destruction which in all probability resulted from seismic shocks are legible in remains of buildings related to the stationing of Roman troops. However, is it possible to record similar damage on such a massive and stable structure as the defensive walls of Chersonesos?

Historical-architectural interpretation

The Hellenistic period

A peculiar fracture of the "core" of Turret XVII in Chersonesos (**Fig. 8**) has already been noticed by Berthier de Lagarde (Bert'e-Delagard" 1907: 121). This scholar remarked that there were no similar traces on a reinforcement (called "the first thickening") surrounding the original structure of the turret. Based on this, one can consider this thickening as a trace of repair of earlier destructions. The first mentioned extension of the turret is dated to the end of the 3rd c. BC (Zubar', Antonova 2001: 50) or to the beginning of the 2nd c. BC (Strželeckij 1969: 16). It is worth stressing that an earthquake as a possible reason of damage of the "core" of Turret XVII was first suggested only by Antonova (1996: 119). This hypothesis was later confirmed by Nikonov. On the other hand, this researcher related traces of destruction to seismic activity in the Roman period in a completely erroneous manner (Antonova, Nikonov 2009: 20).

A fissure is a natural phenomenon in the case of fortifications built on the rock. A hard substratum transmits vibrations, causing more extensive destructions. As mentioned previously, the neighbouring Turret XVI is situated on the axis of the ravine. The structure was founded on the layer of sediments filling the hollow of the terrain. This kind of substratum certainly decreased the spread of vibrations during earthquakes but it did not provide the structure with stability. On the wall faces of the mentioned turret there are no extensive fissures. However, other traces demonstrated that the building swayed and gradually deviated from the vertical. Originally, it was a corner turret in the south-eastern end of the town's walls. Its first rebuilding took place already during the construction of the citadel, which was added to earlier fortifications as a sort of a butt end. The dating of the mentioned extension of the fortifications is based on finds of tombstones from the 4th–3rd c. BC,

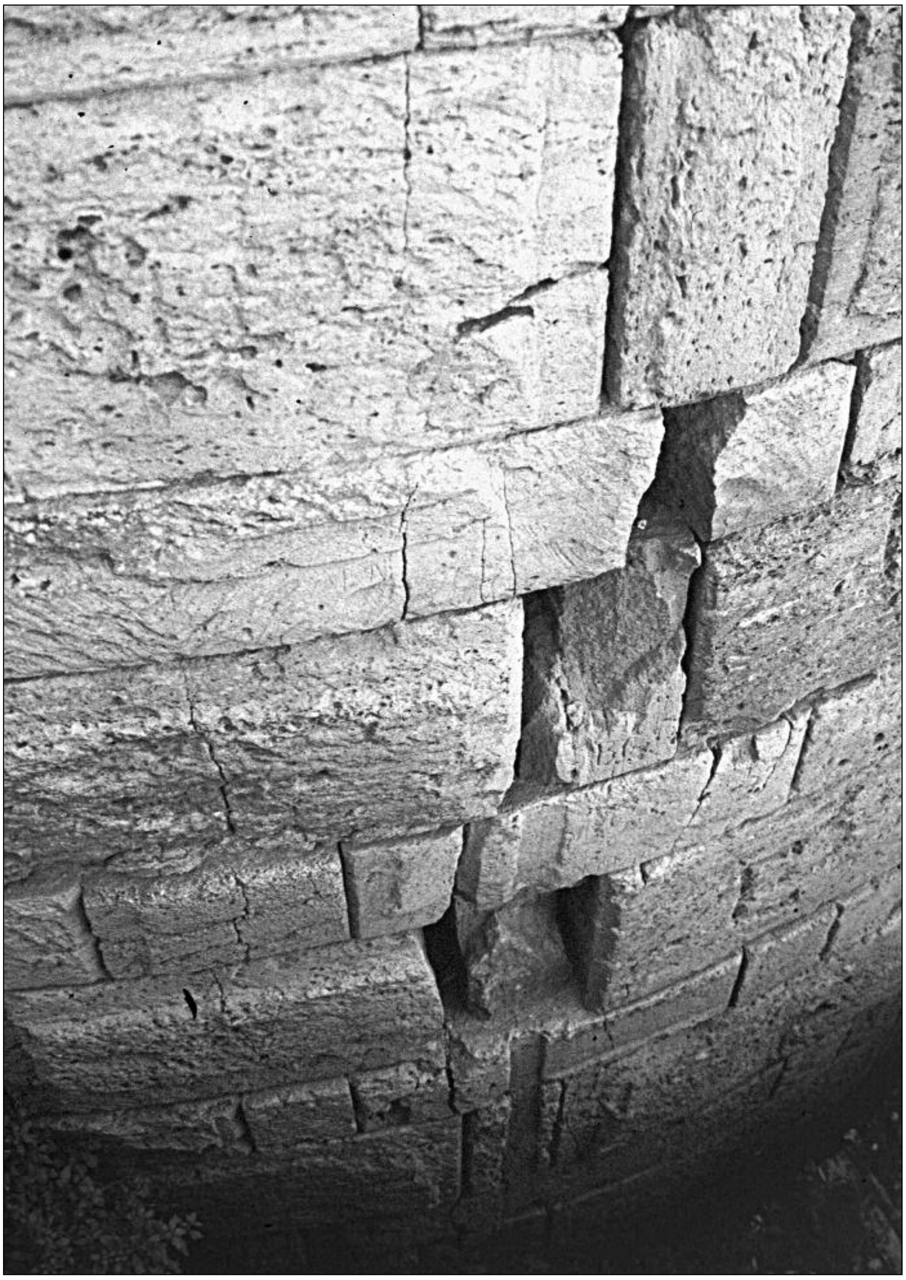

Fig. 8. Chersonesos – the citadel. Turret XVII – the face of the so-called "core of the turret" with a clearly visible fissure and sliding apart of blocks (Photo R. Karasiewicz-Szczypiorski).

Рис. 8. Херсонес – Цитадель. Башня XVII – вид так называемого «ядра башни» с выразительно видной трещиной и расхождением боков.

Ryc. 8. Chersonez – cytadela. Baszta XVII – lico tak zwanego „jądra baszty" z wyraźnie widocznym pęknięciem i rozsunięciem się bloków.

which were secondarily used inside the so-called core of Turret XVII (Strželeckij 1969: 11–17; Antonova 1994: 31; 1996: 119).[1] A precise date of construction of the citadel is unknown. Hitherto suggestions of researchers oscillate between the mid-3rd c. BC (Antonova 1997: 7) and the early 2nd c. BC (Strželeckij 1969: 17). In 1999 Antonova stated that the extension of the fortifications of Chersonesos was to be dated to 230–220 BC, that is, to the period of reinforcement of defensive walls of Kerkinitis and Kalos Limen in the face of the Scythian threat.[2] Newer publications suggest a period between the mid-3rd c. BC and the end of this century (Zubar', Antonova 2001: 49–50).

[1] In her publication from 1994 Antonova mentions Hellenistic tombstones also in other parts of the citadel's fortifications, namely in Turrets XVI and XVIII, as well as in Curtains 19–21. This isolated piece of information provokes many doubts, especially in the case of the mentioned turrets. One of these (Turret XVI) was constructed earlier, while the other (Turret XVIII) is in all probability much later. In the latter case a typesetting error is also possible. Perhaps Turret XVII' was meant, which seems to have been built together with the earliest phase of Curtain 20, that is, in the time of construction of the citadel.

[2] I.A. Antonova, personal communication, July 1999.

In this time, Turret XVI was at least partially dismantled and reconstructed, in an attempt to somehow eliminate the deviations (Koscûško-Valûžinič 1908). Simultaneously, a new curtain (Curtain 19) was built on to it, so that the curtain butted the turret This curtain was part of the citadel's fortifications.

The later origin of the fissure in the "core" of Turret XVII and cracks in the wall of the earliest phase of Curtain 19 can in all probability be linked in time (contra Nikonov – see Antonova, Nikonov 2009: 20). These are perhaps results of the same earthquake. A small extent of damages to Curtain 19 as compared with Turret XVII may result from the same reason as in the case of the leaning Turret XVI. The part of the mentioned curtain which adjoined the turret was also founded on sediments deposited in the ravine. Thanks to this, it was more resistant to vibrations.

To sum up, it is worth underlining that seismic damages of the earliest fortifications should be linked in time with the first traces of repairs. The chronology of these events should be convergent with proposals of dating of the first thickening of Turret XVII, which were discussed above.

In view of the identification of the origin of fissures in the Hellenistic fortifications of Chersonesos one must again ask oneself a question: what made owners of several farms in the *chora* reinforce walls of dwelling towers? Traces of such rebuildings (thickening from outside of the tower walls) were recorded during excavations at, among others, Farms 10, 86, 152, 172, 227, 335, 338 and 340. Thickening of earlier walls was commonly interpreted as a so-called "belt against battering rams" (Kovalevskaâ 1997a: 138; 1997b: 48; Kuziŝin, Ivančik 1998: 215; Nikolaenko 1999: 117; 2001: 74, 124, 126, 127). It seems, however, that inhabitants of the rural territory of Chersonesos were more afraid of seismic shocks than putative Scythian battering rams. Various kinds of thickening of walls, related to removal of results of earthquakes, were applied in the case of turrets at Chersonesos. Why could the same method of reinforcing a building after an earthquake not be also used in neighbouring farms?

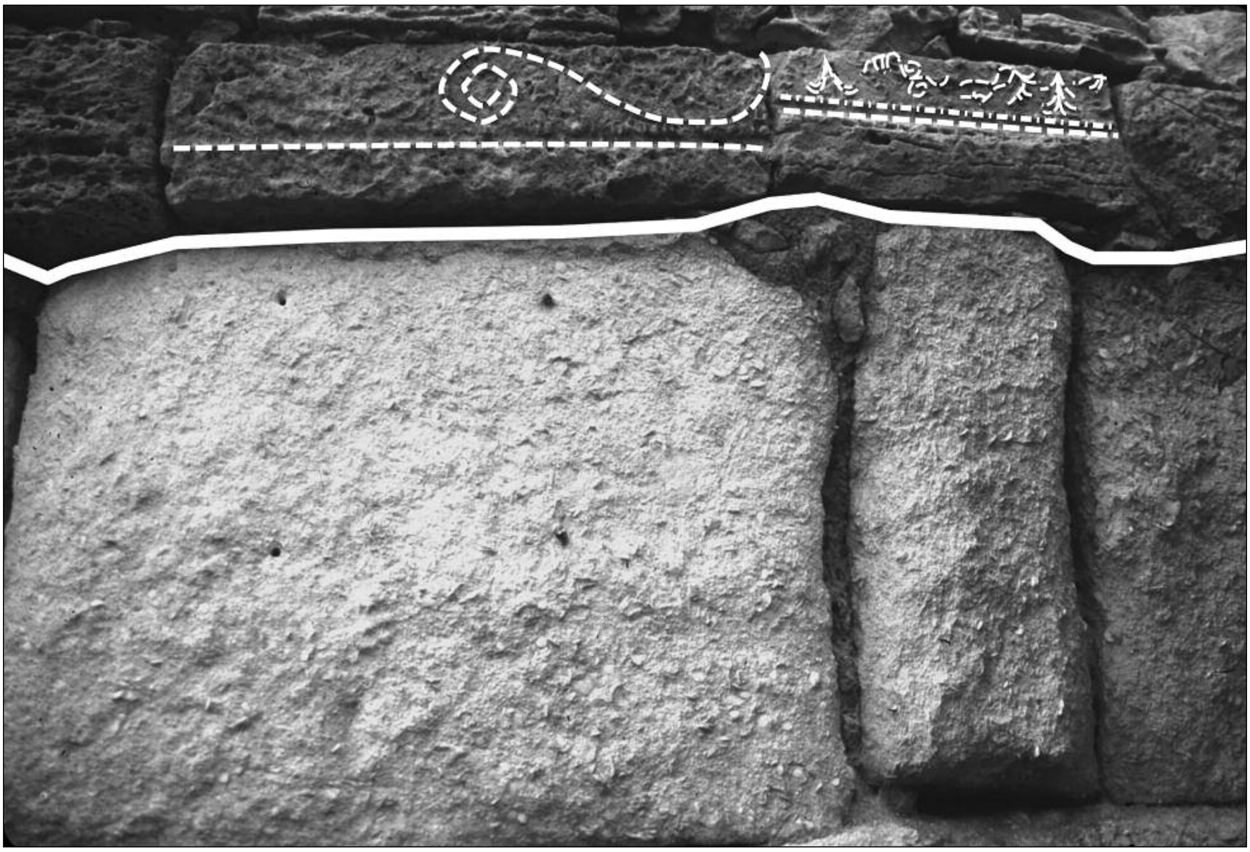

Fig. 9. Chersonesos – the citadel. Turret XVI – the so-called first thickening. Secondarily used architectural details can be seen (Photo R. Karasiewicz-Szczypiorski).

Рис. 9. Херсонес – Цитадель. Башня XVI – так называемое первое утолщение. Хорошо видно вторичное использование архитектурных деталей.

Ryc. 9. Chersonez – cytadela. Baszta XVI – tak zwane pierwsze pogrubienie. Widoczne wtórnie użyte detale architektoniczne.

The Roman Period

A majority of the discussed examples has been long known and they can be relatively easily identified as results of earthquakes. However, research on the walls of Chersonesos in recent years have yielded new facts. Some observations, with a various degree of probability, can be related to seismic activity, also in the first centuries of our era.

Among others, an identification of kinds of applied building material was carried out in surviving remains of the fortifications. M. Krajcarz, a geologist from the Polish Academy of Sciences, isolated 14 types of stone (lithotypes), used by builders in the course of the centuries. Of course, during no building action all kinds of raw materials were used. Special attention is drawn to a selection of several different lithotypes and their peculiar arrangement which was observed in the face of Curtain 17, in a phase which in all probability came into existence in the 1st c. AD (cf. Karasiewicz-Szczypiorski 2014: 91).

The defensive wall was intentionally dismantled or it fell prey to an earlier destruction. During the reconstruction, salvaged stone was used, with a strong share of new and previously unused types of building material. It is probable that the reconstruction was undertaken under the protection of hastily constructed external wall. This event coincides with a supposed intervention of Roman troops under the command of Tiberius Plautius Silvanus in Taurica, which may have taken place in AD 62 (cf. Karasiewicz-Szczypiorski 2014: 88, 92–93).

In this case, it seems that a number of pieces of information forms a logical whole. Chersonesos was believed to be under barbarian threat. An earthquake which in all probability seriously weakened the walls may have been a direct reason for an onrush against the town. The arrival of the Roman relief from Moesia was believed to make the enemy recede from the town (CIL XIV 3608 = ILS 986). In this situation it seems logical that the Romans had to support the reconstruction of the fortifications if they wanted to be able to leave. If fortified again, Chersonesos would not have needed a further (permanent?) presence of the Roman troops. It is worth remembering, however, that there is no certainty with regard to the chronology and reason behind the rebuilding of the mentioned part of the fortifications. Furthermore, we cannot automatically apply observations made on Curtain 17 to the whole of the town's fortifications. Apart from that, the Roman intervention in Taurica about the mid-1st c. still provokes doubts among scholars (Zubar' 1988: 22; 1994: 26–29; 1998: 43; 2003: 14; Sarnowski 2006a; 2006b; 2006c). However, the literature mentions an earthquake in Chersonesos, which may have taken place at the end of the 1st c. AD (Antonova, Nikonov 2009: 17). Regrettably, this cataclysm was not discussed at all in the work of the mentioned authors.

Traces of destructions which probably came into being during an earthquake are also legible in surviving architectural substance and in archaeological layers in the places of stationing of Roman garrisons. Their destruction and later reconstruction are dated to the turn of the 2nd and 3rd c. AD. This issue was discussed in detail above, together with other analogies to damages observed on the walls of Chersonesos.

Turret XVI at Chersonesos, which was also mentioned in this paper, must have leaned again in the end of the Roman period. This is pointed out by the construction of the first thickening (or rather a buttress) on the side of the citadel's interior. The reinforcement of the turret may have taken place at the turn of the 3rd and 4th c. AD (Borisova 1964: 51; Antonova 1996: 121–122; cf. Antonova 1999: 8). It is not known whether it was anyhow related to another earthquake, or merely to a gradual but uneven subsidence of the structure. An example of a similar phenomenon is the famous campanile of the Cathedral in Pisa. Arguments for a hypothesis of a sudden leaning (in result of an earthquake) are provided, however, by the analysis of material which was used for the mentioned thickening. In the structure, a number of fragments of cornices, an architrave and Corinthian trigliphs were used (**Fig. 9**; Koscûško-Valûžinič 1908: 144). It seems very probable that monumental details were used due to the fact that the building from which they came was destroyed. It can be assumed that it is a trace of an earthquake. During this supposed cataclysm, the turret may have leaned again. In other parts of the town at least some buildings must have become seriously damaged, including the structure whose fragments were used in the hastily constructed buttress. However, literature mentions an example of stressing the Christian pressure and dismantlement of pagan temples as reasons behind the use of the mentioned details for repairs of the fortifications (Soročan, Zubar', Marčenko 2000: 513). On this occasion, it is worth mentioning than in the later centuries this turret was at least once more reinforced on the side of the citadel. Traces of another extension of the buttress were discovered during investigations at the beginning of the 20th c. However, they did not survive until present (Koscûško-Valûžinič 1908: 144).

Conclusions

The measurements and analysis of fissures which are legible in surviving remains of the defensive walls of Chersonesos clearly demonstrate that at least part of them came into existence in result of seismic shocks. It is more difficult to respond to a question how to date the recorded destructions and subsequent reconstructions. Based on analysed examples and opinions expressed in publications, the authors of the present paper suggest to isolate five seismic episodes, which left various traces in the surviving architectural substance:

1. The end of the 3rd c. BC (or the beginning of the 2nd c. BC). In this time, among others, Turret XVII in the town was thickened, and so-called "belts against battering

rams" were constructed around dwelling towers at Chersonesos farms;
2. The 60s of the 1st c. AD. This is the most probable date of construction of the first external wall (*proteichisma* – προτείχισμα), which may have come into being as a provisional defence of damaged part of the fortifications;
3. The 10s of the 2nd c. AD. This dating is related to the previous proposal. It is the most probable time of filling up of the outer ward (*peribolos* – περίβολος) in the area of Curtains 16, 17 and 19. The origin of the fill must have been related to another rebuilding of the walls, with a probable participation of the Roman troops (cf. Karasiewicz-Szczypiorski 2014: 92–93);
4. The turn of the 2nd and 3rd c. AD. In this time, a levelling and elevation of the usage level and a general overhaul were carried out in numerous structures in places of stationing of the Roman troops (the citadel in Chersonesos, Balaklava-Kadykovka, Kazatskaya Hill);
5. The turn of the 3rd and 4th c. AD. The buttress was built on to Turret XVI on the side of the citadel. Monumental architectural details were used in the construction of this reinforcement. These may have come from a building destroyed during the same seismic episode which caused the mentioned turret to lean.

While comparing this proposal with results of research carried out by Antonova and Nikonov, it must be first of all stressed that the mentioned scholars do not agree with regard to the chronology of seismic episodes they identified. The earlier independent proposal of Antonova mentions four cataclysms dated to AD 225–250, the second half of the 3rd c., 487, and the first half of the 11th c. (Antonova 1999: 8). The later work, published by Nikonov after the death of Antonova also mentions four cataclysms. However, the first two are dated in a different manner: to the end of the 1st c. AD and to the beginning of the 3rd c. (Antonova, Nikonov 2009: 17). Other scholars pay attention to two strong earthquakes – the first one is dated to the 1st c. BC and the other one to the 3rd c. AD (Panek et al. 2008: 469–471).

While comparing the aforementioned dating of seismic shocks in Chersonesos with statements of the authors of the present paper, it is worth noting that the first two proposals of Nikonov from 2009 are very similar to dates suggested in Points 2 and 3. The dating of one episode to the second half of the 3rd c. by Antonova can correspond to the earthquake mentioned in Point 5.

To sum up, it is worth underlining that the relation of traces described in Points 1 and 4 to earthquakes is definitely more certain. This is demonstrated by a broader horizon of destructions and rebuilds which can be observed at various archaeological sites, also beyond Chersonesos (cf. Antonova, Nikonov 2009: 21–22). So far, in the analysed materials there is no confirmation of the earthquake which took place in the 1st c. BC in Bosporus and is known from literature (cf. Tolstikov 1999; Vinokurov, Nikonov 1998; 2004). The cataclysm dated by other scholars to the 3rd c. seems to correspond to the wave of destruction and repairs which took place around the turn of the 2nd and 3rd c. and were recorded in the course of excavations of Roman posts.

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Abbreviations

CIL – Corpus Inscriptionum Latinarum.
ILS – Inscriptiones Latinae Selectae.
Vitr. *De Arch*. – M. Vitruvius Pollio, *De architectura libri X*.

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Оборонительные стены Херсонеса Таврического. Анализ следов разрушений и восстановительных работ

В 2005–2006 гг интердисциплинарная (междисциплинарная) группа сотрудников Института Археологии Варшавского Университета провела визуальное обследование оборонительных стен Херсонеса Таврического. Были обработаны видимые на дневной поверхности участки фортификационных сооружений. Остатки укреплений анализировались, прежде всего, под углом идентификации видов строительных материалов (Karasiewicz-Szczypiorski 2014 – текст представлен в этом-же номере, стр. 87–112). Также произведена инвентаризация и документирование трещин видимых на поверхности стен. Целью этого второго проекта было установление причин приведших к наблюдаемым повреждениям. Поиск предполагаемых следов землетрясений на оборонительных стенах Херсонеса Таврического начался с выполнения фотофиксации и зарисовки доступных архитектурных реликвий. Полученные результаты впоследствии сравнивались с аналогичными опубликованными материалами из других сейсмических районов.

Анализ собранных данных подтвердил, что значительная часть трещин образовалась в результате сейсмических сотрясений. Это относится к широко известным (также из литературы) пунктам, таким как, например ядро башни XVII, а также нижних частей соседних стен, прежде всего 16 и 19 (**Рис. 1**).

Главным элементом полевых работ были измерения, выполненные непосредственно на стенах. На обследованных участках укреплений произведены замеры более чем на 200 трещинах. Угол их отклонения от нормального уровня измерялся с помощью геологической буссоли. Впоследствии были собраны все измерения выполненные на отдельных стенах. В качестве формы презентации выбраны радиальные диаграммы, по которым легко можно определить чаще всего выступающие уровни наклона углов (**Рис. 2–4**).

Анализируя зафиксированные трещины одинаково рассматривались результаты экспериментальных исследований как и подтвержденные документальн примеры современных разрушений. Обсуждались также случаи предполагаемых сейсмических разрушений на других археологических объектах с хоры Херсонеса. Рассмотрены следы, датируемые эллинистическим и римским периодами.

Опираясь на проанализированные примеры и мнения, представленные в публикациях, авторы данной работы предлагают выделение пяти случаев землетрясений которые оставили после себя разные следы в сохранившемся на сегодняшний день архитектурном материале:

1. Конец III в. до н.э. (возможно начало II в. до н.э.). В это время, помимо прочего, утолщена башня XVII в городе, а также появляются так называемые «противтаранные пояса» вокруг жилых башен на херсонесских сельских усадьбах; В свете представленных выше размышлений кажется весьма вероятным, что жители хоры Херсонеса больше боялись сейсмических толчков, а не предполагаемых скифских таранов. На примере башен в Херсонесе констатированы разные способы утолщения стен произведенных во время ремонтных работ после землетрясений. Возможно по тем же причинам укреплялись башни и на сельских усадьбах? Трудно предположить, чтобы волна сильных толчков земли, которая сильно повредила городские укрепления, оставила нетронутыми близлежащие сельские постройки.
2. 60-е годы I в.н.э. Это наиболее вероятная дата построения первой внешней стены (προτείχισμα), которая могла быть построена как временное обеспечение защиты поврежденного участка укреплений;
3. 10-е годы II в.н.э. Данная датировка связана с предыдущей пропозицией. Наиболее вероятный период

засыпки пространства между стенами (περίβολος) на отрезке стен 16, 17 и 19, что должно было быть связано с очередной перестройкой стен, скорее всего с участием римского гарнизона (Karasiewicz-Szczypiorski 2014: 92–93);

4. Конец II в. н.э. - начало III в. н.э. В это время произведены нивелирование и подъем уровня грунта, а также основательные ремонтные работы на многих объектах в местах дислокации римских гарнизонов (цитадель в Херсонесе, Балаклава-Кадыковка, высота Казацкая около Инкермана).
5. Конец III в. н.э. – начало IV в. н.э. К башне XVI со стороны цитадели пристроена опора. В конструкции этого укрепления использованы монументальные архитектурные детали. Они могли быть взяты из развалин здания уничтоженного во время того же землетрясения во время которого снова наклонилась описываемая башня.

Сравнивая вышеупомянутое предложение к результатам исследований, осуществляемых Антоновой и Никоновым, нужно, прежде всего, подчеркнуть, что упомянутые исследователи не согласны относительно датирования выделенных ими сейсмических эпизодов. В более раннем, самостоятельном предложении, Антонова выделяет четыре катаклизма, датированных 225–250 г., второй половиной III в., 487 г., а также первой половиной XI в. (Antonova 1999: 8). В более поздней публикации, выданной Никоновым по смерти Антоновой, автор также насчитывает четыре катаклизма, но два первых датированы иначе: конец I в. н.э., а также начало III в. (Antonova, Nikonov 2009: 17). Другие исследователи обращают внимание на два большие землетрясения, первое из которых датируется на I в. до н.э. а второе на III в. н.э. (Panek et al. 2008: 469–471).

Сравнивая вышеперечисленные датирования сейсмических волн в Херсонесе с определениями авторов данной разработки стоит обратить внимание, что два первых предложения Никонова с 2009 года очень приближены к датированиям, рекомендованным в пунктах 2 и 4. Датирование Антоновой одного из эпизодов второй половиной III в. может отвечать землетрясению, упоминаемому в пункте 5.

Подытоживая, нужно подчеркнуть, что наиболее вероятна связь следов с землетрясениями, описанных в первом и четвертом пункте. Указывает на это более широкий горизонт уничтожений и перестроек, наблюдаемых на разных археологических памятниках, в том числе и вне Херсонеса (сравн. Antonova, Nikonov 2009: 21–22). В анализируемых материалах до сих пор не хватает данных для подтверждения известного из литературы землетрясения, которое произошло в I в. до н.э. на Босфоре (сравн. Tolstikov 1999; Vinokurov, Nikonov 1998; 2004). Катаклизм, датированный другими исследователями III в., по-видимому, отвечает волне уничтожений и ремонтов, которые происходили около перелома II/III века и были замечены во время исследований на римских постах.

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Mury obronne Chersonezu Taurydzkiego. Analiza śladów zniszczeń i odbudowy

W latach 2005–2006 interdyscyplinarny zespół z Instytutu Archeologii Uniwersytetu Warszawskiego prowadził nieniszczące, nieinwazyjne badania murów obronnych Chersonezu Taurydzkiego. Pracami były objęte odcinki fortyfikacji widoczne na powierzchni gruntu. Pozostałości umocnień analizowano przede wszystkim pod kątem identyfikacji rodzajów budulca (por. Karasiewicz-Szczypiorski 2014 – tekst zamieszczony w tym tomie, 87–112). Przeprowadzono także inwentaryzację i dokumentację pęknięć widocznych na powierzchni murów. Celem tego drugiego projektu była identyfikacja przyczyn obserwowanych uszkodzeń. Poszukiwanie domniemanych śladów trzęsień ziemi na murach obronnych Chersonezu Taurydzkiego rozpoczęto od wykonania dokumentacji fotograficznej oraz rysunkowej dostępnych reliktów architektonicznych. Dokumentacja została następnie porównana z publikowanymi materiałami z innych obszarów sejsmicznych.

Analiza zebranych danych potwierdziła, że znaczna część spękań powstała w wyniku wstrząsów sejsmicznych. Dotyczy to dobrze znanych (również z literatury) punktów, takich jak np. jądro baszty XVII oraz dolnych partii sąsiednich kurtyn, przede wszystkim 16 i 19 (**Ryc. 1**) (por. Antonova, Nikonov 2009: 18, 20).

Głównym elementem prac terenowych były pomiary wykonane bezpośrednio na murach. Na przebadanych odcinkach umocnień dokonano pomiaru ponad 200 spękań. Mierzono ich kąt odchylenia od poziomu za pomocą busoli geologicznej. Następnie zestawiono pomiary wykonane dla poszczególnych kurtyn. Jako formę prezentacji wybrano diagramy rozetowe, z których łatwo można odczytać najczęściej występujące wartości kątów (**Ryc. 2–4**).

Analizując zadokumentowane spękania uwzględniono zarówno wyniki badań eksperymentalnych, jak i udokumentowane przykłady zniszczeń spowodowanych współcześnie. Omówione zostały także przypadki domniemanych zniszczeń sejsmicznych na innych stanowiskach archeologicznych z okolic Chersonezu (por. Antonova, Nikonov 2009: 21–22). Uwzględniono ślady datowane na okres hellenistyczny i rzymski.

W oparciu o przeanalizowane przykłady i opinie prezentowane w publikacjach autorzy niniejszego opracowania proponują wyróżnienie pięciu epizodów sejsmicznych, które pozostawiły różne ślady w zachowanej substancji architektonicznej:

1. Koniec III w. p.n.e. (ew. początek II w. p.n.e.). W tym czasie m.in. pogrubiono basztę XVII w mieście, a także wznoszono tak zwane „pasy przeciw taranom" wokół wież mieszkalnych na chersoneskich farmach. W świetle prezentowanych powyżej rozważań wydaje się bardzo prawdopodobne, że mieszkańcy terytorium wiejskiego Chersonezu obawiali się wstrząsów sejsmicznych, a nie domniemanych scytyjskich taranów. Na przykładzie baszt w Chersonezie stwierdzono różne sposoby pogrubiania murów podczas remontów po trzęsieniach ziemi. Być może z tych samych powodów wzmacniano wieże na okolicznych farmach? Trudno wyobrazić sobie aby fala silnych wstrząsów, która poważnie uszkodziła umocnienia miasta, pozostawiła nietknięte pobliskie zabudowania wiejskie.
2. Lata 60. I w. n.e. Jest to najbardziej prawdopodobna data budowy pierwszego muru zewnętrznego (*proteichisma* – προτείχισμα), który mógł powstać jako prowizoryczne zabezpieczenie uszkodzonego odcinka umocnień.
3. Lata 10. II w. n.e. Jest to datowanie powiązane z poprzednią propozycją. Najbardziej prawdopodobny moment zasypania międzymurza (*peribolos* – περίβολος) na odcinku kurtyn 16, 17 i 19, co musiało być powiązane z kolejną przebudową murów przy prawdopodobnym udziale wojsk rzymskich (por. Karasiewicz-Szczypiorski 2014: 92–93);
4. Przełom II i III w. n.e. W tym czasie dokonano niwelacji i podniesienia poziomu użytkowego oraz gruntownego remontu w wielu obiektach w miejscach stacjonowania garnizonów rzymskich (cytadela w Chersonezie, Bałakława-Kadykovka, Wzgórze Kazackaja.
5. Przełom III i IV w. n.e. Do baszty XVI od strony cytadeli dobudowano przyporę. Do konstrukcji tego wzmocnienia wykorzystano monumentalne detale architektoniczne. Mogły one pochodzić z budowli zniszczonej w czasie tego samego epizodu sejsmicznego, podczas którego ponownie przechyliła się omawiana baszta.

Porównując powyższą propozycję z wynikami badań prowadzonych przez Antonową i Nikonowa, trzeba przede wszystkim podkreślić, że wymienieni badacze nie są zgodni co do datowania wyróżnionych przez siebie epizodów sejsmicznych. Wcześniejsza, samodzielna propozycja Antonowej wymienia cztery kataklizmy datowane na 225–250 r. n.e., 2. połowę III w., 487 r. oraz 1. połowę XI w. (Antonova 1999: 8). Późniejsza publikacja wydana przez Nikonowa po śmierci Antonowej także wylicza cztery kataklizmy, z tym że dwa pierwsze są inaczej datowane: na koniec I w. n.e. oraz na początek III w. (Antonova, Nikonov 2009: 17). Inni badacze zwracają uwagę na dwa duże trzęsienia ziemi, z których pierwsze jest datowane na I w. p.n.e., a drugie na III w. n.e. (Panek et al. 2008: 469-471).

Porównując wymienione powyżej datowania wstrząsów sejsmicznych w Chersonezie z ustaleniami autorów niniejszego opracowania warto zwrócić uwagę, że dwie pierwsze propozycje Nikonowa z 2009 roku są bardzo zbliżone do datowań sugerowanych w punktach 2 i 4. Datowanie przez Antonową jednego z epizodów na 2. połowę III w. n.e. może odpowiadać trzęsieniu ziemi wzmiankowanemu w punkcie 5.

Podsumowując wypada podkreślić, że najbardziej prawdopodobny jest związek z trzęsieniami ziemi śladów opisanych w punkcie pierwszym i czwartym. Wskazuje na to szerszy horyzont zniszczeń oraz przebudów obserwowanych na różnych stanowiskach archeologicznych, także poza Chersonezem (por. Antonova, Nikonov 2009: 21–22). W analizowanych materiałach brak jak dotąd potwierdzenia dla znanego z literatury trzęsienia ziemi, które miało miejsce w I w. p.n.e. na Bosforze (por. Tolstikov 1999; Vinokurov, Nikonov 1998; 2004). Kataklizm datowany przez innych badaczy na III w. n.e. zdaje się natomiast odpowiadać fali zniszczeń i remontów, które miały miejsce około przełomu II i III wieku i zostały zaobserwowane podczas badań na posterunkach rzymskich.