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A BLACK TOURNAI "MARBLE" TOMBSLAB FROM BELGIUM IMPORTED TO TRONDHEIM (NORWAY) IN THE 12TH CENTURY: PROVENANCE DETERMINATION BASED ON GEOLOGICAL, STYLISTIC AND HISTORICAL EVIDENCE

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Abstract

Black Tournai "marble", a fine-grained Lower Carboniferous (Tournaisian) limestone able to take a good polish has been widely used in the Flanders region (Belgium). Highly crafted baptismal fonts and tombslabs were also exported to England, France and elsewhere during the Middle Ages. Such objects are particularly valuable since their distribution aids the dating of historical events and the reconstruction of medieval trade. Similar black "marble" was extracted in the Meuse valley (Belgium) in the Middle Ages, and there are exploited sources in the UK, Ireland and elsewhere. Thus, it is not straightforward to determine the provenance of black "marble". Based on geological, stylistic and historical evidence, this paper shows the likelihood that a black "marble" tombslab found in Nidaros Cathedral in Trondheim (Central Norway) was extracted and crafted in Tournai and shipped northwards around 1160, possibly for the grave of the first Norwegian archbishop, Jon Birgerson. The tombslab represents the first crafted stone imported to Norway from the European continent/British Isles and is thus unique in a historical context. The properties of the Trondheim tombslab match those of black Tournai "marble": It is a silicified, bioclastic packstone loaded with crinoids, featuring bryozoa and fragments of brachiopods and ostracods. The high silica content and absence of foraminifers distinguish the stone from the Viséan black "marble" quarried in the Meuse valley.

Keywords: Black marble, provenance, Tournai, Belgium, Norway

Introduction

In 1884 a finely carved, but very damaged tombslab (Figure 2B, 3-4) was discovered during restoration works at Nidaros cathedral in Trondheim (Central Norway, Figure 1), which was the seat of Europe's northernmost archbishopric from 1152-53 until the Reformation in 1537. Incorporated in the ceiling of a wall passage in the SE-corner of the Gothic triforium of the central tower (Figure 2), it was soon realised that the tombslab had been relocated. This relocation, or reuse as building material, must have taken place already during the erection of the tower's triforium in the 13th century. It has been suggested that the tombslab originally belonged to the prominent earl Erling Skakke (d. 1179, father of King Magnus Erlingsson), whose grave was possibly located outside the south wall of the 11th century choir (Fischer 1965: 266-7, 651; cf. Ekroll 2001: 13). Although the sparse remains of ornamentation earlier suggested a link to Sweden (Undset 1888: 71), the provenance of the tombslab has never been seriously discussed.

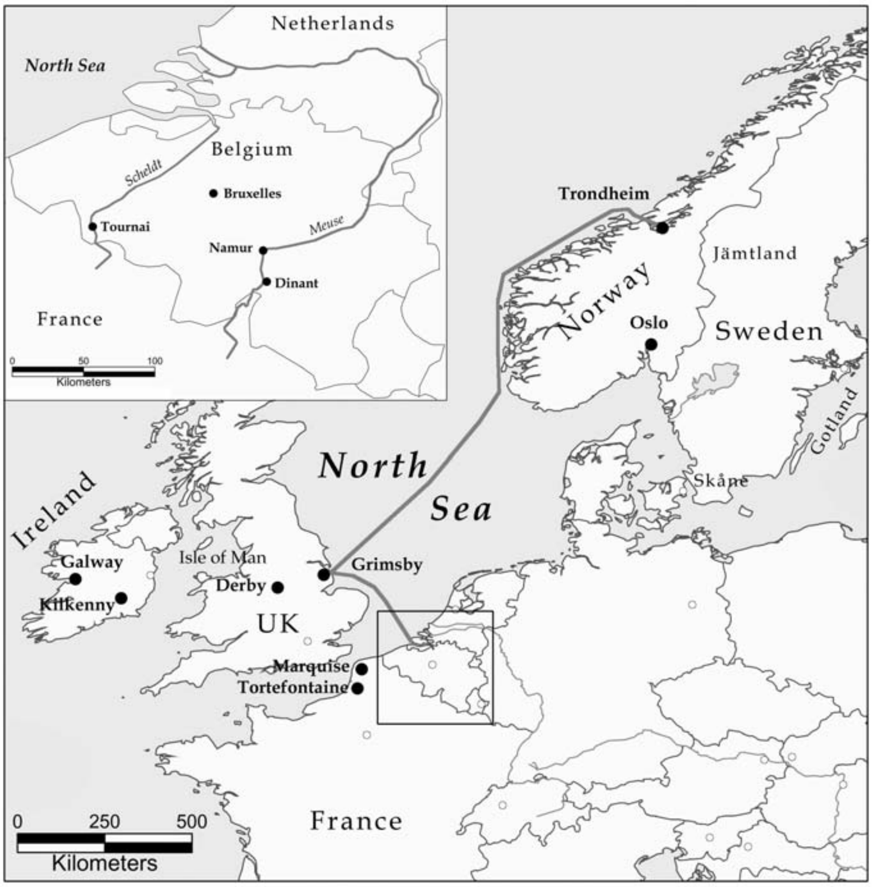

Figure 1: Map of NW-Europe showing the location of important places mentioned in the text. A possible route by sea from Flanders to Trondheim is marked (see below).

Due to the form of the ornamentation and the tombslab's uniform black colour, the question was recently raised whether it could rather originate from the famous Tournai workshops (Flanders, Belgium) in the 12th century (cf. King 2002: 18). This would have implications for the understanding of the distribution and transportation of carved black Tournai "marble" objects in the Romanesque period/Middle Ages. Moreover, the slab would represent the first known highly crafted stone imported to Norway from the European continent/British Isles. In Trondheim, medieval tombslabs are predominantly made from regional white marble, as well as from soapstone and greenschist (Ekroll 2001; cf. Storemyr 1997, 2003). These are also the main stone types used for tombslabs elsewhere in the country, except in the SE-part, where various granitic stones were often applied. There are no other known black medieval tombslabs in the country. However, quite a few light grey limestone tombslabs were imported from Gotland and Estonia in the late medieval period (from c. 1400) (Ekroll, pers. comm.). Baptismal fonts, related to tombslabs in terms of production and distribution, were also rarely imported in the Middle Ages. Such objects were usually made from soapstone, and only a dozen fonts made from Gotland limestone are known in Norway, mainly in the SE-part (Solhaug 2001).

Black Tournai "marble", a dense, fine-grained Lower Carboniferous (Tournaisian) limestone, quarried along the Scheldt River by Tournai and able to take a good polish, has been widely used in the Low Countries since Roman times. Highly crafted baptismal fonts and tombslabs were also exported to England, France and elsewhere during the Middle Ages and later, and they constitute an important source for the dating of historical events and other scholarly discourse (see, for example, Rolland 1924; Camerman & Rolland 1944; Ghislain 1974, 1993; Schwarzbaum 1981; Groessens 1981, 1987; Dimes 1990: 93-95, Nys 1993, Anderson 1996, Drake 1993; Drake 2002, King 2002). However, it has often been disputed as to whether many of the objects may rather originate from quarries in rather similar limestone deposits in the geologically slightly younger Viséan in the Dinant-Namur-Liege region in the Meuse valley (cf. Van Welden 1965, de Henau 1965, Anderson & Groessens 1996: 133, King 2002: 1; Groessens 2003a, b). Also quarries situated in the north of France (e.g. Marquise, Bologne) (cf. Groessens 2003a, b), as well as in the Lower Carboniferous of the British Isles and Ireland have been mentioned as possible sources (Dimes 1990: 93-95). The main problem of differentiating such black limestones is that visual criteria will not suffice (Dimes 1990: 94-95; Groessens 2003a).

With the working hypothesis that the Trondheim tombslab originates in Tournai, this paper discusses the geological, stylistic (art historical) and historical evidence for such a provenance, mainly based on optical microscopy, chemical analyses, XRD, literature/archive research and observation of various black marble objects in Belgium, France and England. Moreover, the paper discusses other sources of "black marble". It also examines the condition and weathering history of the tombslab, especially to provide arguments as to whom it may have belonged.

The work undertaken relies on the methodological assumption that problems related to provenance of stone objects should be resolved by interdisciplinary efforts, enabling the establishment of better founded theories than if relying on geological and archaeometric evidence alone. This is not least due to the often very limited possibilities of sampling such historically and culturally significant objects (if it can be done at all), sometimes implying great uncertainty related to whether the samples are representative or not. However, in this case, due to the damaged state of the tombslab, there was no problem in obtaining two small, representative samples.

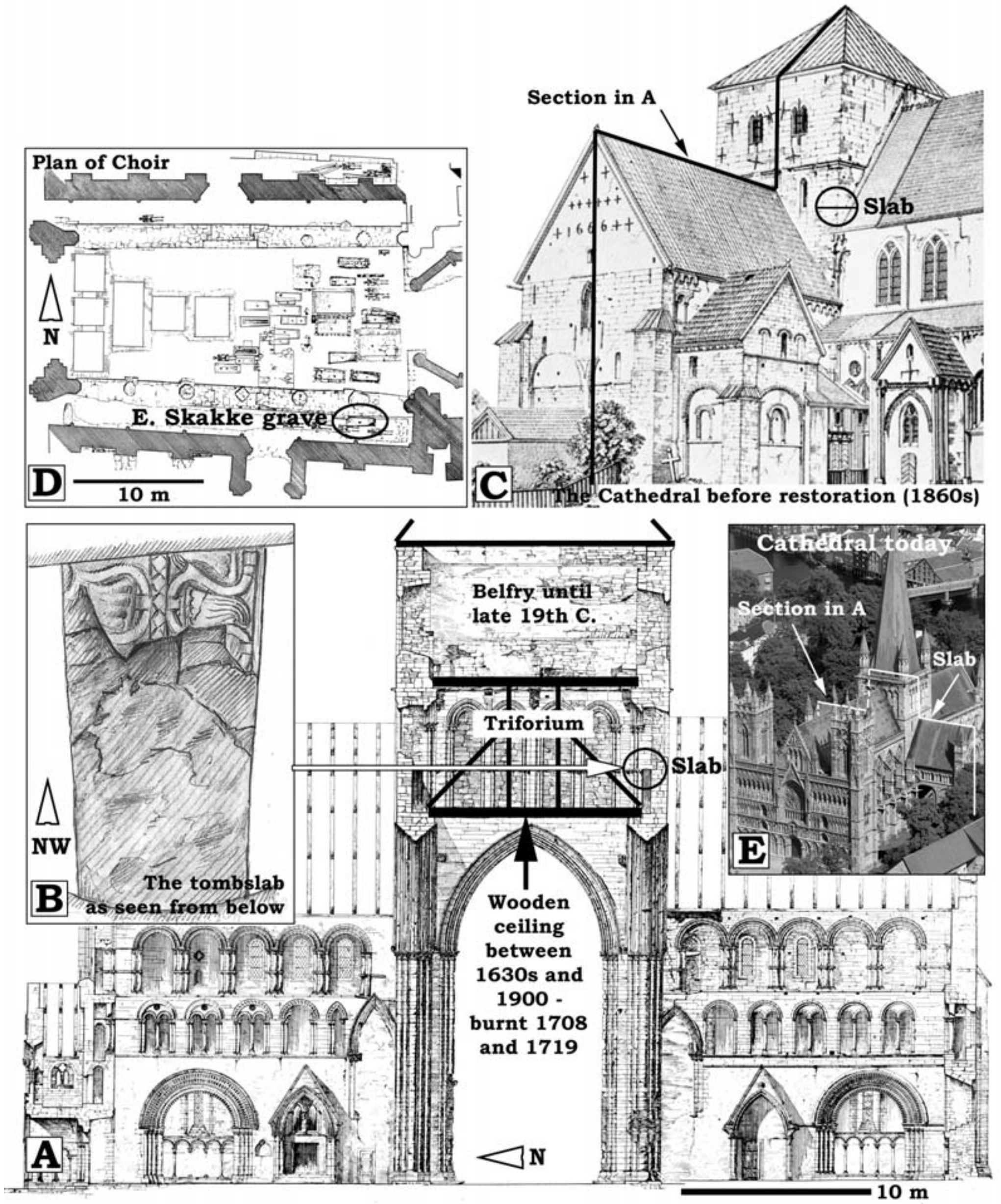

Figure 2: The current location of the tombslab (denoted "Slab") and various features of the Cathedral mentioned in the text. A: Section of the transepts and central tower as seen towards E. Before the modern restoration, which started in 1869. The slab is located (reused as building stone) in the ceiling of a wall passage in the SE-corner of the triforium with its carved surface facing down (section by Christie, 1880s). B: Drawing of the damaged tombslab by Bergstrøm, 1884. C: View of the south transept, central tower and choir before restoration, seen from SE (drawing by Schirmer, 1840s). D: Plan of the choir and graves found during excavation in 1866. Note the grave labelled E. Skakke, which is located outside the 11th century choir, but within the Gothic choir that was built in the same period as the central tower triforium (13th century). E: View of the cathedral from SW as it appears today after restoration between 1869 and 1969. All illustrations from the Archive of the Restoration Workshop of Nidaros Cathedral. See also Fischer (1965).

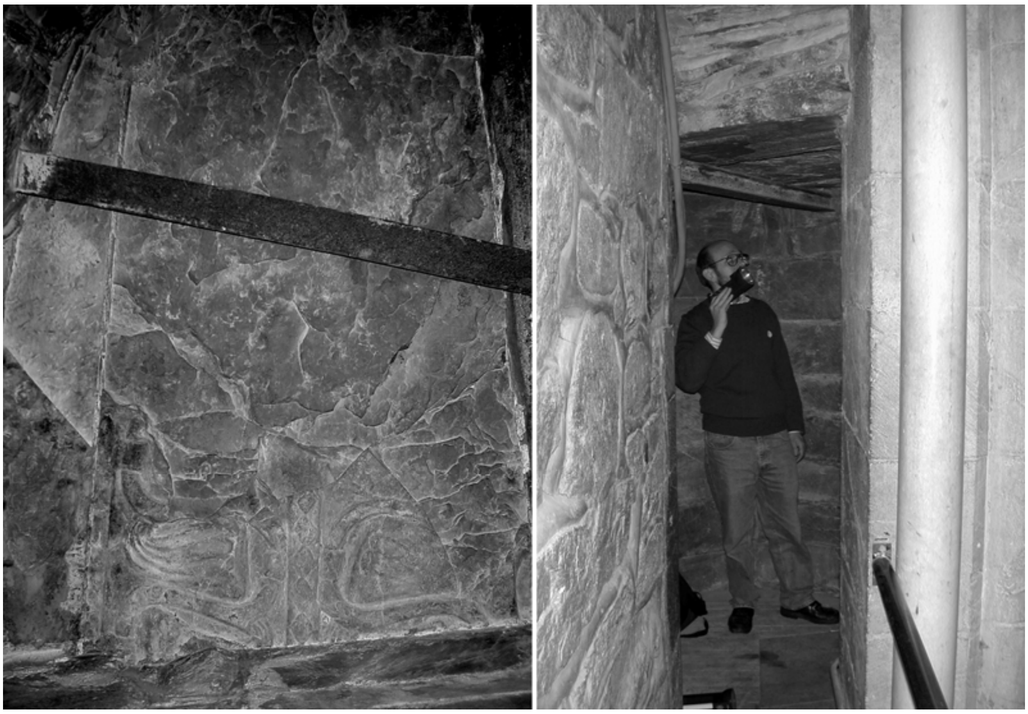

Figure 3: Left: The visible part of the tombslab from below. Right: Photo showing the location of the slab in the wall passage of the tower's triforium. The passage is open towards the interior of the church (e.g. by the white marble column). The iron beam was inserted to support the masonry during restoration works in the late 19th century.

The Trondheim tombslab and its weathering history

Due to its strange location in the ceiling of a wall passage in the SE-corner of the Gothic triforium of the central tower, is not easy to properly describe the Trondheim tombslab. This is because both ends of the slab are hidden in surrounding masonry, which, on the other hand, is the best evidence for the incorporation of the slab in the triforium during its erection in the 13th century. There is no indication that the masonry of this part of the cathedral was rebuilt or heavily reconstructed at a later date. However, the storey *above* the triforium (the clerestory) was rebuilt as a simple belfry in the 16th century – after a devastating fire in 1531. This storey was again reconstructed in Neogotic style at the end of the 19th century (Fischer 1965, Lysaker 1973, see also Figure 2A, C, E).

The *visible* length of the slab is now 140 cm, the width 87 cm by the remaining ornamentation on the north side, tapering towards the damaged part, where the minimum visible width is 64 cm (Figure 2B, 3). However, since both ends are hidden, the slab is considerably longer, probably in the range of 180-200 cm. The thickness is difficult to measure, but should be in the order of 15-20 cm. The remaining ornamentation covers less than 50 cm of the visible length of the slab (but might well continue in the hidden parts) and includes stylised leaves along angular stems (*rinceaux*, a form of vine) carved on either side of a band with a series of diamonds (Figure 2B, 3). No head motifs appear on the surviving decorated section, but comparisons with similar work elsewhere (see below) suggest that the slab may have included such decoration.

The major part of the slab is extremely weathered in the form of multiple delamination (up to dm-size "flakes") and cracking, forms that one would expect from influence of heavy frost and/or fire (Figure 3, 4). The delaminated "flakes" are sound and hard, and there are barely signs of very small flakes or granular disintegration (which is typically an indication of salt weathering). With delamination as the most important weathering form, it is easy to observe the finely laminated structure of the fine-grained stone. It is possible that the brownish to greyish patina on the slab made early investigators believe that the stone had "a reddish colour" (Fischer 1965: 651). However, looking at broken pieces from the deteriorated part, it is clear that the original colour is very dark grey to black, perhaps with a bluish tint. Careful examination of the slab has not revealed particular features such as white patches or spots (other than patina) or macroscopically visible fossils. The slab seems to be very uniformly dark grey to black.

According to Fischer (1965: 267, 651), the dimensions of the slab correspond with the only stone tomb found just outside the (former) 11th century choir of the cathedral (Figure 2D). As mentioned in the introduction, Fischer also speculated whether the slab belonged to this tomb, thought to have been for Erling Skakke (d. 1179). If this were correct, the slab would have been exposed to the elements for many decades, before the tomb became included within the aisle of the new Gothic choir, which was built in the 13th century. Thus, the present damaged condition could have been due to rain and frost in an exterior environment. This could also have been part of the reason why the slab lost its value, was removed and reused as building material. In this connection it is important to bear in mind that Tournai marble is susceptible towards frost (see below, and Camerman & Rolland 1944: 48ff).

However, during the building of the Gothic choir (and generally throughout the history of the cathedral) it was not uncommon to reuse any kind of sound, but outdated or unfashionable (or partially damaged) tombslab, sculpture and architectural element as building material. In the foundation ditch of the Gothic choir, for example, pieces of older tombslabs were found during excavations; "the veneration does not seem to have been very pronounced" (Fischer 1965: 267, our translation). Moreover, long, solid stones were not easy to come by in the traditional quarries of the cathedral (Storemyr 1997), implying that "our" tombslab may in fact have been well suited for the ceiling in the tower's triforium. This could imply that the condition of the slab was fine, although perhaps with superficial damages, by the time it was removed. The characteristics of the weathering forms of the slab, with many very large (dm-size), partially detached flakes, appearing as if they could fall any moment, also supports this suggestion. If this weathering predominantly took place before the relocation, one would have expected the slab to be roughly redressed, at least partially. There is no evidence that redressing ever took place.

Figure 4: Left: The slab in the 1960s. Photo by the Restoration Workshop of Nidaros Cathedral. Right: An impression of the delamination of the slab.

There is, however, ample evidence that the bulk of the weathering took place after relocation of the slab to its current position. This is because this part was directly or indirectly influenced by at least three of the five fires that struck the cathedral between the Middle Ages and the 18th century (1328, 1432, 1531, 1708, 1719; Fischer 1965; Lysaker 1973). A most destructive fire may have been the one in 1531 since at that time the storey above the triforium became so damaged that it had to be rebuilt (see above). The rebuilding took place 30-40 years later, and even if it is assumed that a temporary wooden belfry was raised shortly after the fire, the tower must have been like a ruin for a long time (Fischer 1965: 262; Lysaker 1973: 42). Although the masonry above the slab is massive, water could easily have penetrated the walls and wall heads through cracks and open joints, saturating the slab and make it vulnerable towards frost as the tower was in a ruined condition.

We have no indications of the direct influence of the three first fires, but in 1708 and 1719 the slab may have been struck badly, if only for a short time (shock heating). This is because in this period the triforium supported a large wooden ceiling spanning the whole interior of the tower (Lysaker 1973: 84 and Figure 2A). Above this ceiling were a loft and a belfry with massive wooden constructions. Before the ceiling collapsed, high temperatures may have occurred in the passage by the tombslab.

Except for massive restoration in the late 19th century (cf. Figure 2C, E) there has been no dramatic events influencing the tower since 1719. The slab is now enjoying a rather constant indoor climate in this heated part of the church (Storemyr 1997: 143ff). Over the last century very little seems to have happened to the tombslab (compare Figure 2B, 3 (left) and 4 (left))

Observations, and analysis of surface deposits on the slab

Is there any observable traces and analytical evidence supporting the suggestion that weathering predominantly took place after the relocation? Since the surrounding masonry was thoroughly repaired during the restoration in the late 19th century, there are hardly any observable traces of fire today (spalls, cracks, brown staining). However, the lack of fire damage may also be due to the fact that the masonry is predominantly made from very heat-resistant soapstone – a main building material at the cathedral (Storemyr 1997). The lack of staining might also be linked to the limewash that covered parts of the masonry from the 16th century until it was removed during the restoration (Fischer 1965: 256f, Lysaker 1973, Storemyr 1997: 116). Given that temperatures were high enough, it might thus be that the tombslab was selectively affected during one or more fires. This is supported by the fact that the slab is intensely silicified (see description below); quartz-containing rocks are known to be vulnerable towards fire. Moreover, since the slab appears to be under more tension (due to its placement) than surrounding masonry, this may also have contributed to it being selectively affected by fire (cf. Kieslinger 1949: 426ff, Winkler 1994: 241ff).

Recalling that earlier observers described the surface of the tombslab as "reddish" (se above), analyses of scraped-off powder was undertaken with oil-immersion polarising microscopy and microchemistry (following methods given in Bläuer Böhm 1996). Shock heating of limestone will normally not give rise to many surface effects (e.g calcination or colour change); it will primarily cause cracking and surface-parallel spalling (Kieslinger 1949). It was nevertheless thought that the surface deposits could give clues to influence by fire or other events. The powder originated from a small flake (sample T2, c. 2x1x0.5 cm) from the delaminated part (well away from the carved remains of which a plaster cast was taken in 1884; therefore this area cannot be used for reliable analyses of surface deposits). Upon breaking the flake the typical smell of H_2S gave an indication of the organic content giving the stone its black colour. The "fresh" stone contains an overwhelming amount of microfossils, fine-grained calcite and opaque minerals interpreted as pyrite can also be seen. To some extent this assemblage can also be found in the loose surface crust. The crust is made predominantly from gypsum and incorporates very fine-grained calcite particles and some quartz, as well as small pieces of charcoal (opaque, elongated, angular and "splintery" under the microscope) and traces of nitrate. In addition there are microorganisms (not further determined) and quite a few strongly brown particles interpreted as minerals stained by oxidised iron (iron hydroxide). The crust on the underside of the flake shows a similar composition, excluding charcoal, stained particles and nitrate.

As for the charcoal (and stained particles) in the loose crust, they give no clue to the *effect* of fire; they merely show that something burnt in the surroundings, which is hardly surprising. However, the presence of much gypsum is interesting because it shows that the slab in periods must have been very thoroughly moist. Theoretically, gypsum might have formed on the slab if it was once placed outside the cathedral. However, gypsum would probably not have remained on the surface for long because of rain-washing. It is therefore suggested that the gypsum primarily formed after the slab was placed in its current position. Its origin is easily explained by the generally high pyrrhotite content of surrounding building materials, providing sulphate, an issue discussed at length for the cathedral as such in Storemyr (1997). Sulphate may also have been provided from the slab itself (given that it contains pyrite). Due to the weathering forms of the tombslab, it is unlikely that gypsum has contributed much to delamination (by exerting crystallisation pressure). However, its presence in large amounts can be taken as an indicator of conditions moist enough to account for frost damage as the tower was in a ruined condition. Moisture may not only have been provided from leaks – extreme condensation can also be the source, as has frequently been observed at unheated parts of the cathedral today (Storemyr 1997: 245ff).

The once ruined condition of the tower and evidence of strong fire in this part of the cathedral suggest that the current very heavy damages primarily happed after the slab was relocated to its current position. However, it does not mean that the slab cannot have been slightly damaged before it was relocated. From this perspective the tombslab might have belonged to the tomb of Erling Skakke outside the old choir, but the weathering observed today cannot be used as an *argument* to further this hypothesis. This of course also implies that the tombslab may have been situated inside the cathedral and belonged to another person. Before turning to this question, the geological evidence for the provenance of the slab will be discussed.

Geological evidence: Tournai or Meuse?

We have chosen to discuss the geological provenance of the Trondheim tombslab together with its stylistically closest companion, a very well preserved slab in Tortefontaine in Northern France (Figure 6). On stylistic grounds this slab is apparently of Tournai production (cf. Ghislain 1993: 141), but its provenance has not yet been geologically determined. Thus, it is included here to back up the stylistic discussion in a later section.

Analytical results

The Trondheim samples used for analyses (no. T1 and T2) were both loose, but sound, flaky fragments, c. 2x1x0.5 cm, obtained from the deteriorated part of the tombslab. Also a small fragment of similar size, the Tortefontaine sample (T4) had fallen from the tombslab and was collected by James F. King by a visit. Sample T1 and T4 were petrographically studied by thin section analyses using a polarising microscope, while sample T2 was chemically and mineralogically investigated (X-ray diffraction - XRD).

Sample T1 and T4 (Figure 5) are very similar bioclastic packstones (classification after Dunham 1962) with a fairly limited amount of pores and many stylolites, often filled with calcite. They are intensely silicified, silica replacing the calcite matrix as chert. No individual quartz grains were identified, nor were quartz veins observed. Numerous small crinoids and crinoid fragments (up to 100 µm in diameter), shell fragments (brachiopods, ostracods) and bryozoa were obvious, but the stones were lacking foraminifers. This concurs extremely well with descriptions of “black marble” from Tournai by Van Welden (1965).

Sample T2 was dissolved overnight in 1N HCl to dissolve all $CaCO_3$ present. This showed a calcite content of 81% in the T2 limestone. The remaining material was subsequently treated with 36% H_2O_2 to eliminate all organic material. This revealed an organic material content in the original limestone of 2% (responsible for the black colour). The remaining 17% insoluble residue was investigated by XRD. This showed that almost the entire residue consisted of quartz (silica – SiO_2), a minor fraction being clay minerals.

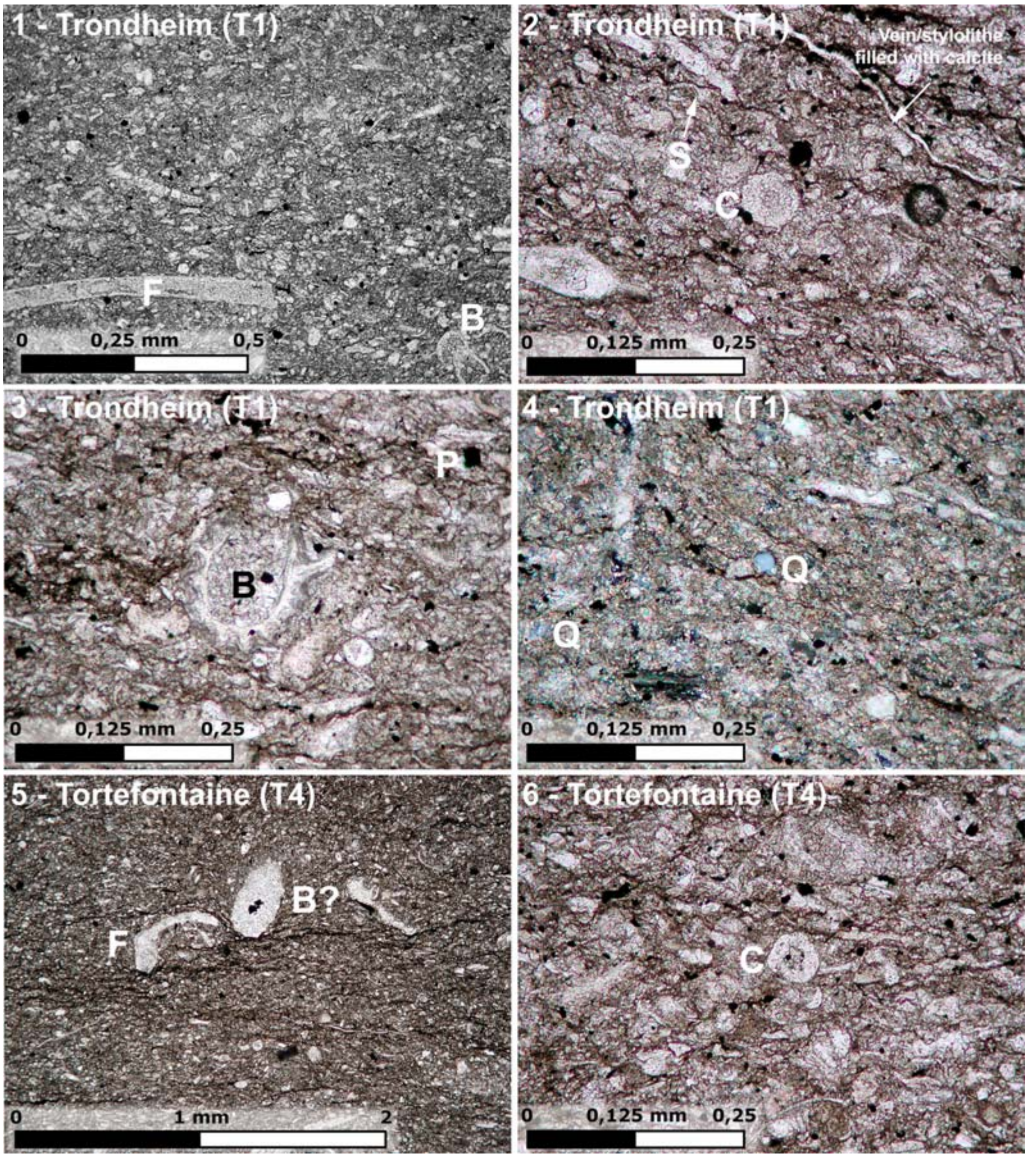

Figure 5: Photomicrographs, thin sections of the Trondheim (T1, 1-4) and Tortefontaine (T4, 5-6) tombslabs. Micrographs taken with normal light, except # 4, which is taken with crossed polars. Note the laminated structure. Key to some important features: Q = Silica replacing calcite as chert; S = Stylolithes; F=Shell fragments (brachiopods, ostracods etc.); B=Bryozoa; C=Crinoids; P=Pyrite.

Geology of Belgian stone: Tournai versus Meuse limestone

The Carboniferous in Belgium is subdivided into three well-described units: the Dinantian at the base, characterised by marine limestones, the Namurian with more terrigenous deposits and the Westphalian with sedimentary rocks deposited in a lacustrine environment (Groessens, 2001a: 8). The Dinantian is further subdivided into the Tournaisian (354 to 342 Ma) and the Viséan (342 to 327 Ma; Groessens, 2001a: 3). The sedimentary history of the Dinantian is explained by the stable tectonic configuration of the area (Groessens, 2001a: 8), in which platform carbonates were deposited (Groessens, 2001b: 159).

All exploited hard limestone in Belgium originates from the upper Devonian to the Lower Carboniferous (Groessens, 1988: 14). Well-known dark limestones and/or “black marbles” from Belgium have been exploited mostly around the rivers Meuse and Scheldt. Most well known are the *Calcaire de Meuse-Vinalmont* limestones of Viséan age along the river Meuse on the one hand, and the limestones of Tournaisian age called the *Petit-Granit*, *Noire de Denée* and the “black marble” from Tournai (*Noir de Tournai*) on the other hand (Groessens, 1988: 154)

Hence, geologically, Meuse and Tournai “black marbles” or limestones are not of the same age, nor do they possess the same lithological structure. The Mosan limestone is mostly of middle Viséan age, showing a typical association of foraminifera and algae (Anderson & Groessens, 1996: 134). The lack of foraminifera and the occurrence of bryozoa in the Tournaisian limestone were already reported by Van Welden (1965: 162). Hence, though they have the same black colour, no confusion is possible between the Meuse and the Tournaisian limestone in thin section microscopy. They are petrographically clearly different, the latter being geologically older as shown by its fossil content (Anderson and Groessens, 1996: 135). Sample T1 (Trondheim) and T2 (Tortefontaine) are therefore certainly not a Mosan limestone.

Confusion as to the geological age and the palaeontological content (e.g. Groessens, 2001a: 12) is possible between the Tournaisian upper beds of the Petit-Granit limestones, called the *Noir de Denée* (Groessens, 1987: 82) and the “black marble” from Tournai. However, it has been clearly described that the $CaCO_3$ content of these upper beds is very high, always higher than 95% (Van Welden, 1965: 152; Groessens, 2001a: 12, see also Camerman & Rolland 1944: 9ff), sometimes up to 99% (Groessens, 1987: 81). Our sample (T2) of “black marble” showed a $CaCO_3$ content of around 81%, clearly indicating that its origin cannot be found in the *Petit Granit*, but must lie in the deposits of the *Noir de Tournai*. Since the Tortefontaine sample (T4) is also strongly silicified, it is likely that the same argument holds for this stone.

Weathering characteristics

Black Tournai limestone is often described as prone to weathering and as especially susceptible to frost (Camerman & Rolland 1944: 48ff). Typical descriptions related to probable Tournai objects include: "...the stone takes a crumbly, slaty appearance" (Nijs 1992: 62); "...it is liable to fissurate and it is schistic." (Anderson &

Groessens 1996: 133); "...its use in sculpture is limited, for it is schistous – almost laminated...there is hardly a piece without signs of flaking or splitting" (Drake 2002: 3). This reflects the geological circumstances and most Tournai "black marble" varieties are described as schistose or laminated (Camerman & Rolland 1944: 7f). According to Anderson & Groessens (1996: 133), this is not the case with objects made from black Mosan limestone, although the same authors also point out that this may be due to the differentiation by the quarrymen of "good from bad stone" (Anderson & Groessens 1996: 135).

Clearly, with its delaminated (or "flaky", "schistous") appearance, the Trondheim tombslab fits well with the descriptions of Tournai stone above. The same also seems to hold for the much better preserved Tortefontaine slab. However, as it cannot be ruled out that Mosan and other black limestone objects in some cases may also delaminate, this weathering form does not appear to be a diagnostic criterion for differentiation. It may well serve as an indicator, though.

Other sources of black limestone considered

The colour, texture, structure, microfossil content and intense silification of the Trondheim and Tortefontaine tombslabs very strongly indicate that they are of black Tournai limestone, and not from the Meuse district. In order to check whether they could originate elsewhere, several known black limestone deposits with a *medieval* quarrying history in France, UK, Ireland and Sweden have been evaluated. Norwegian limestone is also briefly included. With regard to the Tortefontaine tombslab, only the French deposits would be relevant (cf. the stylistic and historical discussion later).

France

In addition to Tournai and Meuse, the Marquise area in the north of France could have been a possible source for especially the Tortefontaine tombslab. Marquise has been a very important quarrying area since the time of Napoleon, but the history goes back to the Roman period. Limestones from the Devonian until the Cretaceous are found in the area, e.g. the oolitic *Pierre de Marquise* of the Jurassic era. The coloured, compact limestones or "marbles" appear mainly to be found in the Upper Devonian and Lower Carboniferous (Viséan) beds of the Marquis area (Groessens 2003a). Although some dark varieties can be found here, to our knowledge it seems no *medieval export* tradition is recorded, and in our literature studies we have not come across references to the production of medieval tombslabs.

UK

In the UK black Carboniferous limestone is particularly found around Ashford-in-the-Water in Derbyshire (late Viséan in age) where the famous "Derby Inlay Work" (*pietra dura*) was made between the 17th and 19th centuries. Although the early history is obscure, the use of the stone has a tradition at least back to the 15th

century (Ford 1997). However, a tradition for export of tombslabs and other objects does not seem to exist here, although the stone may be more widespread than usually considered. The commonly worked Derby Black is "consistently fine- and even-grained and almost totally free of chert or other silification" (Ford 1997: 144), somewhat "muddy" and sometimes "crowded with fossils" (Dimes 1990: 93). Thus, this is not in line with the characteristics of the Trondheim tombslab. There exist other dark to black limestones with a quarrying history on the British Isles, particularly of Devonian age (e.g. Plymouth Black, cf. North 1930: 116ff). However, the majority of these limestones have visible "streaks, veins and blotches" (Dimes 1990: 89f) and no medieval export tradition seems to be recorded.

Ireland and Isle of Man

Irish black limestones were traditionally quarried in Galway, Kildare, Kilkenny and Limerick. They are mainly Carboniferous (North 1930: 145; Dimes 1990: 94; cf. Holland 2001), but little has been written about their characteristics, use and medieval history. According to Dimes (1990: 94) these "marbles" were widely used in Victorian times; they are generally speckled with white veins, patches and spots (sometimes white fossils). Thus, if this also relates to varieties possibly quarried in the Middle Ages, it seems they are not similar to the one we are looking at in Trondheim. Moreover, Groessens (2001: 3) states that Irish crinoidal limestones are of Viséan age, and thus it should be possible to differentiate them from Tournaisian limestone by their palaeontological content (e.g. by algae and corals).

In the Isle of Man, which (like Ireland) had a strong connection to Norway in the Middle Ages (Man was part of the Norwegian Archbishopric), there is another Lower Carboniferous (Viséan) black limestone ("Poolvash") with a local quarrying history at least back to the 14th century (http://www.pooilvaaish.com). This "black marble" was obtained from the "flaggy and shaly Posidonomya Beds". It was used for local purposes, also for tombstones, but since it seems to have been too soft to take a natural polish, it was covered with a kind of black varnish in order to make it look like Derby Black (Lamplugh 1903; Ford 1993:40; see also http://www.isle-of-man.com/manxnotebook). This softness does not match the properties of the Trondheim tombslab.

Sweden and Norway

Turning to Sweden, to which the Trondheim tombslab was earlier thought to have a connection (see above), there is no Carboniferous crinoidal limestone in the country. There are, however, a couple of dark Ordovician Orthoceras limestone deposits with a quarrying tradition back to the Middle Ages. One is the famous Komstad limestone in Skåne in the far south, a dark grey to black, rather homogeneous micritic limestone. Apparently it is never completely black/dark, as it contains white spots of fossils and secondary calcite. Another can be found in the Brunflo area in Jämtland, some 200 km due east of Trondheim. The dark variety of this stone is a rather schistose and characteristically features bioturbation (with secondary calcite) and nodules, giving it a somewhat inhomogeneous appearance (Löfvendahl 1996:102ff, pers. comm.). These two stones certainly do not match the properties of the Trondheim tombslab.

There is also Ordovician Orthoceras limestone in the Cambro-Siluran successions in the Oslo region in Norway, from which quarrying of various, mainly light-coloured or greyish varieties, took place in the Middle Ages. Homogeneous black "marbles" with a quarrying tradition are unknown in the Orthoceras formations and in other deposits (e.g. dark crinoidal limestones in the SW-part of the Oslo region). The Cambro-Silurian of the Oslo region is often characterised by contact metamorphism due to Permian intrusives. In other Cambro-Silurian areas of Norway the limestones have generally been subject to regional metamorphism and alteration, and thus they are out of the question as sources for the Trondheim tombslab. Moreover, no black crinoidal limestones are known here (Vogt 1897; Holtedahl 1912, 1960; Lidén 1974; Ekroll 1997).

Stylistic evidence

In this section the stylistic or art historical evidence of an origin of the Trondheim tombslab in the Tournai workshops rather than locally in Norway will be discussed.

The motif of rinceaux (vine as found on the Trondheim tombslab) is a common decoration; it was employed across western Europe throughout much of the Middle Ages, but its appearance in Norway would seem to begin only around 1130, following on from the so-called Urnes style (named after a stave church in the western part of Norway). Neither the Urnes style, nor comparable types of rinceaux in other stave churches has, however, any close similarities with the Trondheim tombslab. This is also true for other Trondheim tombslabs (cf. Ekroll 2001), as well as for various architectural decorations from the 12th century at the Nidaros cathedral. In fact, there is no decorative work found anywhere in Norway from which this uniquely decorated rinceaux could feasibly derive, nor is there any apparent influence from it. There are, however, closer similarities with certain decoration found outside Scandinavia, primarily in England, Belgium and Northern France.

In England, the closest comparisons with Trondheim decoration occur on the Tournai-marble baptismal fonts and tombslabs, imported in the twelfth century (e.g. Schwarzbaum 1981; Drake 1993; Anderson 1996; King 2002). The decoration there sometimes includes clasps on either side of an undulating stem, with large, heavily veined leaves carved along it but, in general, the stems are not of an angular type and the leaves are not quite the same as those found in Trondheim. Of the carved work found in England, the closest comparison for such large leaves, emanating directly from simple stems, is to be found on a tombslab at Lincoln Cathedral, but even these are not particularly close matches with those at Trondheim.

Figure 6: The Tournai black "marble" tombslab at Tortefontaine in France, the closest comparison to the Trondheim tombslab. Photo by James F. King

Only in Belgium and Northern France does one find significantly close stylistic comparisons, especially with regard to leaf forms. Among the closest, apparently of Tournai production, are the baptismal font at Zillebeke (near Ypres, Belgium, usually dated c.1160 or earlier) (Ghislain 1975: 52) and the large tombslab in Tortefontaine (Ghislain 1993: 141) (which most probably is from Tournai, as shown above). Both these places were, in the 12th century, within the jurisdiction of the Count of Flanders. Somewhat similar leaf forms are also found at Tournai (Belgium) itself, though not in association with rinceaux. There is also very similar rinceaux with a central band found on the fragments of the baptismal font at Escanaffles (Belgium), and there are related decorative motifs on a capital from the abbey of Cysoing (Belgium), as well as on a tombslab from the former abbey at Ename (Belgium) (Ghislain 1983; 1993: 142). Zillebeke, Tournai, Escanaffles, Cysoing and Ename are all located either on the Scheldt River or on a tributary of it.

The carved decoration on the tombslab at Tortefontaine (France), however, is by far the closest in style and execution to that found in Trondheim, so much so that the two are likely to have been carved within the same workshop. The few differences between the decoration of the two tombslabs are minor. The Tortefontaine tombslab is coped, not flat; it has no intermediary collars between the leaves and the main stem; and the central dividing band is plain. There are also four heads, each placed centrally along one of the four edges, from which the rinceaux emanates (Figure 6). It may well be that the Trondheim tombslab featured heads in the now missing (or hidden) parts.

There are also striking similarities with certain aspects of various baptismal fonts thought to be of Mosan production (eg. at Gentinnes in Belgium and at Lesquielles-St. Germain, in France). Of these baptismal fonts (no tombslabs from this region have relevantly related decoration), the closest comparison is to be found at Nouvion-le-Vineaux (France), near Laon, arguably of similar date to the large baptismal font at Laon Cathedral, though there of an alternative decoration (Tollenaere 1957: 289). The Nouvion-le-Vineaux font leaves are different in that they are paired and occur alongside grapelike clusters, a feature which compares favourably with earlier work from Tournai but not found at Tortefontaine, Trondheim or Zillebeke. A date in the 1160s has usually been put forward for both of these baptismal fonts.

Historical evidence

The historical evidence is mainly connected to recorded contacts and trade between Norway and/or Scandinavia and Flanders in the late 11th and 12th centuries, but many of these connections assume England as intermediary. In the 9th century Vikings raided and destroyed many religious institutions in Flanders, but there is little recorded after this until the late 11th century. Norwegians wintered in Flanders (and sometimes England) when travelling further south. In fact, the earliest surviving "portolano" (11th century, from Denmark) (David 1936: 15-16) specifically records the route to the Holy Land via Flanders. Despite this apparent contact, however, mercantile connections, both with eastern England and Flanders, do not become clearly established until later in the 12th century, when an apparent shift in trade away from the west coast of England and Ireland seems also to take place.

It would appear that the Cistercians in Yorkshire, and particularly in Lincolnshire, were primarily responsible for the increased trade in wool, which was shipped to Flanders to be made into cloth. Of the two biggest exports to Norway (mentioned already in 1186), the first was wheat from England and the second cloth from Flanders (Leach 1921: 38, 48). It was, in fact, Archbishop Eystein of Trondheim who managed to secure a license permitting an annual duty free shipload of grain from England (Leach 1921: 94). In Flanders, the development of the cloth trade occurs exactly at the same time, in the area around Ghent and Ypres, with its main market at Arras, on the Scarpe River (a tributary of the Scheldt River) (Liebaers *et al.* 1985: 19-21). In 1115-20 Grimsby (Lincolnshire) is mentioned as a port used widely by Norwegians (Leach 1921: 41).

It is noteworthy that the early trade in wool/cloth was based largely both in Lincolnshire and along the Scheldt River (and its tributaries) in Flanders. Of the three main areas to receive sculpted Tournai-marble work in England, Lincolnshire stands out (alongside Winchester). It is, moreover, indeed Lincolnshire that was the main recipient of Tournai work, specifically tombslabs, in later centuries. It is certainly possible that Norway learned of such products at an early date from this region, though the Trondheim tombslab shows a more direct exchange with Flanders itself. The early development within Britain of the trade in sculpted works of Purbeck "marble" (Blair 1991: 41-56) and the St. Albans group (based along the tributaries of the River Thames) (Thurlby 2001: 162-175), both c.1160, may help to explain the drop in interest in Britain for Tournai marble.

The first specific references which suggest travel across Flanders by Norwegians come in the 12th century through the necessary contacts between the archbishops of Trondheim and the pope, especially in connection with the establishment of the new archbishopric in 1152/53. Although disputed, the first Archbishop of Trondheim, Jon Birgerson, seems to have travelled to Rome in 1151 when he was still bishop of Stavanger (Storm 1888: 60), and in 1160-61 Archbishop Eystein went the same way to receive the pallium. Modern scholars have suggested the likelihood that both went via England (Hohler 1964: 94; Wilson 1986: 97) and, if so, it is likely via Flanders. Contact with the pope would have been essential for the archbishops of Trondheim. This would not always have meant a journey to Rome, however, as the pope was often in France. From this it can be argued that Norwegian ecclesiastics, at least in the twelfth century, regularly crossed through Flanders on church matters, and it is not totally unlikely that Archbishop Eystein may have seen a tombslab like the one at Tortefontaine.

After Archbishop Eystein returned to Trondheim in 1161, he complained that the church finances were poor. This may also have been a veiled criticism of the quality of building of the churches and cathedrals in Norway, as a marked change in the refinement of sculpture and finely dressed stone occurs specifically from the early 1160s onwards. It seems probable that certain masons and sculptors were brought to Norway by Eystein, as there is no earlier tradition for much of the work, and the stylistic relationships with foreign work are too strong to have evolved from earlier Norwegian production. For instance, Archbishop Eystein's "Chapter House" by the Nidaros Cathedral, built probably in the 1170s, is unique in Norway and it has been discussed widely by scholars both in Norway and elsewhere. The majority of these scholars suggest a strong stylistic relationship with the east end of York Cathedral, under construction in the later 1150s (e.g. Syrstad 2001; Wilson 1986; Fischer 1965: 569). But other comparisons make it quite likely that more direct influence from Flanders also occurred at Trondheim and/or York.

Dedication of the tombslab

Comparisons with work in Flanders and earlier work in England point to a date for the Trondheim tombslab of the late 1150s or 1160s (with an outside bracket of c. 1155 to 1180). If this is correct, then there are few possibilities for the person for whose grave the tombslab was intended. The effort and cost alone limit the tombslab to someone of importance. There are only four such people reportedly buried at Nidaros Cathedral at this time: Archbishop Jon Birgerson (d. 1157), King Haakon Herdebrei (d. 1162), Erling Skakke (d. 1179) and Archbishop Eystein (d. 1188). According to Fischer (1965: 2), Archbishop Eystein was buried in the Chapter House, but Ekroll (2001: 10) argues that he was buried in the Octagon (the east end of the cathedral). Haakon Herdebrei was apparently first buried elsewhere in Norway and later reburied in the wall of the Cathedral on the south side of the choir (Sturlason 1932: 716). Erling Skakke, as we have seen, may have been buried outside the south wall of the Cathedral, his grave only becoming part of the interior space in the later rebuilding. The location of the tomb of Archbishop Jon is not known.

As discussed in this paper, the damaged state of the tombslab cannot be used as an argument for an original location outside, since the bulk of the weathering is likely to have occurred as the slab was already relocated to the central tower. Thus, probably with the exception of Haakon Herdebrei, the tombslab may have belonged to any of these persons. However, according to the stylistic comparisons, a date around 1160 seems most appropriate for the carving of the tombslab. This would suggest that it belonged to Archbishop Jon Birgerson, first Archbishop of Trondheim. Where his tomb was located in the cathedral is another story. And although the relocation of the tombslab and its use as a building stone in the 13th century central tower triforium is clearly related to the expansion of the cathedral and the rebuilding of the choir, exactly why it was relocated is also another story.

Concluding remarks

Stone is not only a material for functional purposes. Since the ancient Egyptians the use and distribution of stone has been determined by ideology, fashion, trade relations, technology, economic circumstances, and, for many stone types, their status among the elite (Bloxam 2003). This is particularly true for "marble", since antiquity a term used for any stone able to take a good polish. Since the Roman period and throughout the Middle Ages black Tournai marble and other similar marbles were elite-status stones. Thus, it is not surprising that a tombslab of the highly priced black Tournai marble also ended up in Trondheim, very possibly for decorating the grave of the first Norwegian archbishop shortly after 1160. Being the first highly crafted stone imported to Norway from the European continent/British Isles, both geological and stylistic evidence very strongly points towards the tombslab having originated in a Tournai workshop. This is supported by historical evidence of contact between Norway and Flanders in the 12th century.

Although in this case the provenance of the tombslab seems clear, there are many other cases, as mentioned in the introduction to this paper, where the provenance of medieval black marble objects remains obscure. Differentiating between black marble from Tournai, Meuse, Northern France, England, Ireland and other countries may not be very problematic from a geological perspective, given that representative samples can be obtained for analysis. However, such studies are hampered by the fact that no systematic inventory of historical black marble sources exists. Such an inventory ought to include relevant quarries, their tradition of extraction and use, as well as modern descriptions and classification of the various stones obtained. In cases where sampling is impossible, some indications of provenance can possibly be obtained from simple tests. For example, black Tournai marble is much more silicified than black Mosan marble, thus the ability of the former to very easily scratch glass may be an indicator. As the silification is a replacement of the calcite matrix, it is quite homogenously present throughout the rock, and hence the scratching test is not difficult to perform. Also the strong tendency to show delamination as a main weathering form can be used as an indicator of provenance.

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