# POTASSIUM-ARGON DETERMINATIONS ON SOME LONDON MEDIEVAL HONESTONES

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In a recent survey of the provenance of 9th- to 15th-century AD British metamorphic honestones (Crosby and Mitchell, 1987) conventional potassium-argon (K-Ar) whole-rock isotopic ages (Mitchell, 1972) were measured on fifteen specimens from medieval London sites (Fig. 3). Two principal types of metamorphic honestone are recognised in Britain during this period, the Norwegian Ragstone (NR) and the Purple Phyllite (PP). The objective of the nationwide study was to relate these honestone types to similar artefacts from Norway and Northern Europe by comparing their isotopic ages and thereby to identify possible source areas for the PP type. These two metamorphic honestone varieties were previously identified and discussed by Ellis (1969) and Moore (1978; 1983) whose work has overlapped (Moore and Ellis, 1984). Discussions with one of these authors (D. T. Moore) has ensured that the NR (Ellis' IA(1)) and PP (Ellis' IB(1); Moore's Blue Phyllite) terminologies used in our separate studies do refer to the same metamorphic honestone lithologies.

Petrological identification of the specimens was by close visual examination and comparison with honestones from other collections. Where doubt existed, thin-sections were examined and compared with 'typical' NR and PP slides provided by the British Museum (Natural History).

Previous isotopic studies of European metamorphic honestones (Mitchell *et al.*, 1984; Myrvoll, 1985) have shown that the ages of the NR group lie in the range 860–960Ma, which is clearly distinguishable from the 390–470Ma age range of the PP group (see Figs 1 and 2). Nine of the London NR specimens yielded K-Ar ages consistent with their petrological classification, whilst three specimens of NR gave ages significantly lower than would have been expected.

Age reduction in such metamorphic material has been attributed to 'weathering' (Kars, 1983), though the work of Crosby and Mitchell (1987) indicates that significant age perturbations may arise from exposure to heating. Kars (1983) had also noted that some Dorestad honestones had been discoloured whilst others had their appearance completely altered by heating in a fire. Two indicators of the exposure of NR to heat were distinguished by Crosby & Mitchell, these being (i) surface discolouration to light brown and (ii) increased natural remanent magnetisation (NRM). Because the intact London specimens were too large to be accommodated in the instruments used to measure NRM, colour was the only criterion which could be exercised to distinguish possible heating.

Of the three anomalously low NR ages, two (showing no evidence of discolouration) were further investigated by thin-section examination to confirm the validity of their petrological classification. Of these ⟨3158⟩, a quartz-muscovite-calcite-ore bearing schist is almost certainly NR from its foliation, mineralogy and texture (D. T. Moore, pers. com.). The other

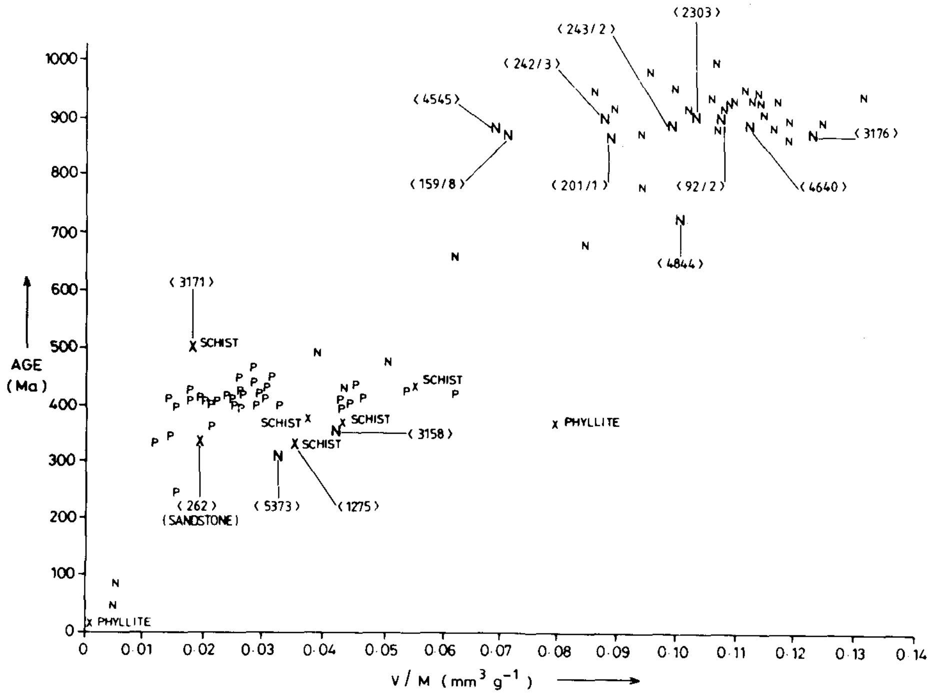


Fig. 1 European metamorphic honestones: potassium-argon age (Ma) versus radiogenic argon content (V/M, $mm^3g^{-1}$).

N Norwegian Ragstone (NR)
P Purple Phyllite (PP)
X Other

**N** )London samples with
**P** )full honestone number

(adapted from Figure 9, Crosby and Mitchell, 1987).

⟨5373⟩, a quartz-muscovite-zircon-ore bearing schist shows some textural similarity to NR (D. T. Moore, pers. com.). The third discordant age, that of NR honestone ⟨4844⟩, appears to be a consequence of the honestone being heated, since the specimen has a recognisable light brown colouration. Further investigation of these three honestones, utilising NRM measurements might help to resolve the question of the cause of these younger ages.

The main body of results (9 NR honestones) lies towards the lower age limit of the NR grouping. Together they show an elongated distribution in Figs 1 and 2. This configuration leads us to suggest that these honestones may have been subjected to groundwater leaching to varying degrees leading to loss of potassium and radiogenic $^{40}Ar$. It has been shown (Mitchell and Taka, 1984), that in the initial stages of weathering of micas (the main potassic mineral in NR), argon loss is balanced by potassium loss leading to a slight reduction in isotopic age. Honestones ⟨4545⟩ and ⟨159/8⟩ have the lowest potassium contents, 1.9% $K_2O$ in comparison with 2.6% for *in situ* Eidsborg schist, the probable source of NR (Crosby & Mitchell, 1987). Both these honestones were a light brown colour. It is possible that this discolouration was due to iron deposition during fluctuating water levels

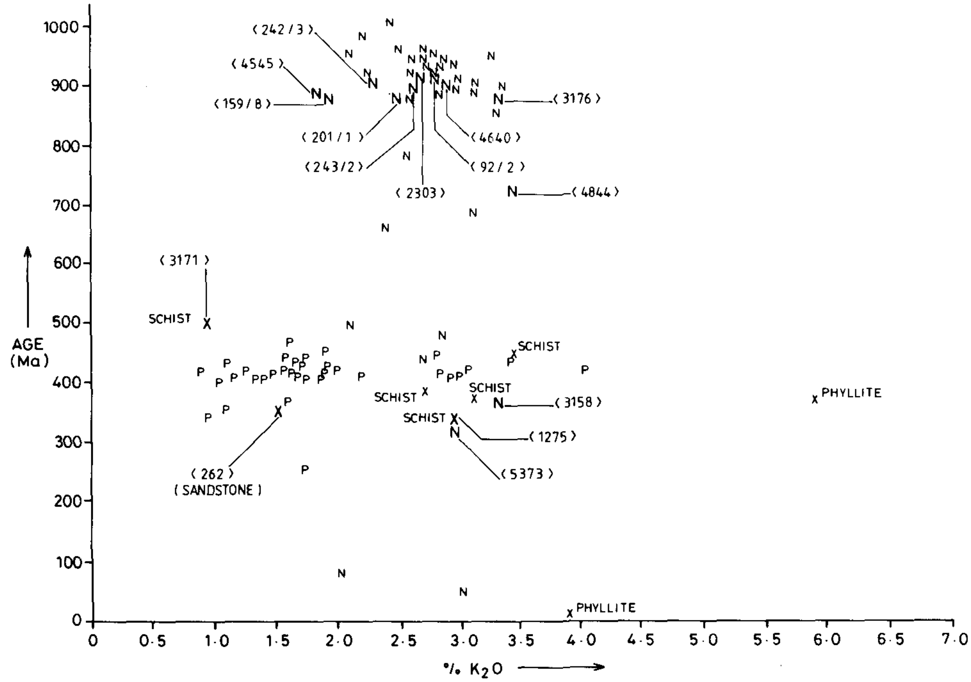


Fig. 2 European metamorphic honestones: potassium-argon age (Ma) versus potassium oxide content ($K_2O$). Symbols as for Fig 1. (adapted from Figure 10, Crosby and Mitchell, 1987).

within their archaeological contexts, or that it indicates exposure to heating. At the time of writing both explanations are plausible and NRM measurements would prove helpful in resolving this problem.

The three honestones that are neither NR nor PP are distinguishable from the two major metamorphic groups, two visually, and the third through thin-section evidence. Honestone ⟨3171⟩ had previously been identified as a hornblende schist (D. T. Moore, pers. com.). Hornblende is indicative of high grade metamorphism and as such would not normally be expected to be associated with either the mica-rich NR or PP. This honestone's position in Figs. 1 and 2 lies outside both of the two main groups. It also lies outside the heat-induced migration trend of NR points towards the origin (Crosby & Mitchell, 1987). The second non-NR schist ⟨1275⟩ has the visual appearance of a phyllite yet on thin section evidence it was identified as a quartz - actinolite - muscovite - zircon - ore bearing schist (D.T. Moore, pers. com.). Its K-Ar age of 330 Ma does not correspond with either of the main groups, although its potassium content is similar to the NR.

The final result of 349Ma comes from a sandstone ⟨262⟩. It is noteworthy that this age corresponds to K-Ar results (342 and 366Ma) reported for two silt-sandstone honestones from Dorestad (11008 and 5485 respectively) described by Kars (1983). The archaeological age of Dorestad was reported as 675—mid-9th century AD (Kars, 1983), and although ⟨262⟩ could not be archaeologically dated its archaeological 'age' is probably similar to those from London which could be dated,

| Site | Context Number [ ] | Accession Number ⟨ ⟩ | Rock Type | Archaeological Dating | %$K_2O$ | Ar (V/M) × $10^{-2}$ | %AC | Age (Ma) |
|---|---|---|---|---|---|---|---|---|
| BC72 | 123 | 4545 | NR | mid/late 14th C | 1.87 ± .06 | 6.88 ± 0.05 | 6.0 | 884 ± 11 |
| BC72 | 250 | 4640 | NR | mid 14th C | 2.90 ± .03 | 10.94 ± 0.12 | 2.5 | 901 ± 14 |
| BC72 | 150 | 4844 | NR | late 14th C | 3.44 ± .03 | 9.98 ± 0.08 | 4.0 | 729 ± 9 |
| BIG82 | 5552 | 3158 | NR | late 14th C | 3.32 ± .01 | 4.26 ± 0.06 | 5.6 | 359 ± 5 |
| BIG82 | 4747 | 5373 | NR | late 14th C | 2.98 ± .01 | 3.23 ± 0.04 | 5.9 | 308 ± 4 |
| LUD82 | 1077 | 92/2 | NR | late 13th/early 14th C | 2.80 ± .03 | 10.68 ± 0.08 | 4.2 | 909 ± 12 |
| LUD82 | 1076 | 159/8 | NR | late 13th/early 14th C | 1.92 ± .01 | 7.04 ± 0.05 | 8.4 | 881 ± 8 |
| LUD82 | 1143 | 201/1 | NR | late 13th/early 14th C | 2.45 ± .01 | 8.87 ± 0.07 | 3.7 | 873 ± 8 |
| LUD82 | 1122 | 242/3 | NR | late 13th/early 14th C | 2.29 ± .01 | 8.69 ± 0.07 | 4.5 | 906 ± 8 |
| LUD82 | 1140 | 243/2 | NR | late 13th/early 14th C | 2.63 ± .01 | 9.85 ± 0.07 | 6.1 | 896 ± 7 |
| SWA81 | 2109 | 3176 | NR | early/mid 15th C | 3.35 ± .07 | 12.25 ± 0.09 | 5.0 | 879 ± 19 |
| TL74 | 2529 | 2303 | NR | late 13th/early 14th C | 2.68 ± .02 | 10.25 ± 0.07 | 5.2 | 911 ± 9 |
| POM79 | 641 | 262 | SST | not known | 1.57 ± .01 | 1.95 ± 0.03 | 20.1 | 349 ± 6 |
| SWA81 | 2279 | 3171 | SCHIST | early 13th C | 0.97 ± .01 | 1.80 ± 0.04 | 64.0 | 499 ± 12 |
| TL74 | 274 | 1275 | SCHIST | early/mid 15th C | 3.00 ± .02 | 3.51 ± 0.03 | 11.9 | 330 ± 4 |

%$K_2O$ Weight percent potassium oxide content.
Ar(V/M) Radiogenic Ar-40 as volume per sample mass ($mm^3g^1$).
%AC Percent Ar-40 atmospheric contamination.
Age (Ma) Calculated geological age (Millions of years).

Decay constants used: $\lambda_e = 0.581 \times 10^{-10}$ (per year).
$\lambda_B = 4.962 \times 10^{-10}$ (per year).
${}^{40}{}_{K/K} = 0.01167$ atom percent.

Fig. 3. London hones—K-Ar data adapted from Tables 2 and 3 in Crosby and Mitchell (1987).

namely 13th–15th century. The provisional conclusion of Kars (1983) was that the Dorestad silt-sandstone honestones could be grouped with the 'Kentish Rag' from the Lower Cretaceous in south–west England (Ellis, 1969; Moore 1978, 1983). Isotopic age criteria are not useful in characterising sedimentary rocks since in almost all cases the measured isotopic age is not that of sediment deposition, but the average of the ages of the rock fragments which make up the sediment. Consequently isotopic methods are of little use in provenancing silt-sandstone material.

Strong petrological and isotopic age evidence suggests that the Eidsborg quarries of southern Norway are the geographical source of the NR hone material (Ellis, 1969; Moore, 1978; Moore, 1983; Mitchell *et al.*, 1984; Myrvoll, 1985; Crosby and Mitchell, 1987). Recent work by the authors (Crosby and Mitchell, 1987) indicates that the probable source of the PP material will lie within central-southern Norway.

## THE ARCHAEOLOGICAL CONTEXT OF THE HONES

ALAN VINCE

All but one of the analysed honestones come from a stratified context dated by associated finds or dendrochronology. Archive reports exist for these sites and have been deposited in the Museum of London Records Department. The exception is from the Post Office Middle site (DUA code: POM79), which at the time of writing was still undergoing post-excavation analysis. It should be noted that to identify any sample reliably the site code, the context number and the accession number are needed. In figures 1 and 2 the accession numbers are used to distinguish the samples. These numbers are, luckily, unique within this project but the accession numbers start at one for each site.

### Baynard House, Queen Victoria Street (BC72)

A stone-walled inlet, the site of the East Watergate, was found in 1972 underneath the west wing of the 16th-century Baynards Castle. The west wall of the inlet was formed by a reclamation dump, [250], behind a stone wall. It is roughly dated to the middle of the 14th century by pottery and coins.

Silt at the base of the inlet, [123], contains mid to late 14th-century pottery and coins, while the inlet was backfilled at some stage late in the 14th century, [150]. The infill appears to have consisted of contemporary rubbish with little, if any, residual material.

### Billingsgate Market Lorry Park, Lower Thames Street (BIG82)

The excavation at Billingsgate Lorry Park revealed a sequence of timber waterfronts, ranging in date from the middle of the 12th to the middle of the 13th centuries. The analysed honestones come from a mid to late 12th-century dump behind the Period VII waterfront ([4747]) and a late 12th-century dump behind the Period VIII ([5552]) waterfront.

### 42–6 Ludgate Hill/1–6 Old Bailey (LUD82)

Excavations in front of the city wall at Ludgate Hill revealed the butt-end of the city ditch. Four successive recuts were identified but the majority of the site was occupied by the final ditch, Ditch 4, which was backfilled at some time in the late 13th or early 14th century. A single coin dates to later than 1310 and the site was definitely built over by 1340. A notable feature of the backfill was a deposit of Norwegian Ragstone chippings, which were obviously freshly dumped in the ditch at the time of its abandonment. All five samples came from hones from the Ditch 4 backfill.

### Swan Lane Car Park/95–103 Upper Thames Street (SWA81)

In the watching brief following the excavation at Swan Lane, various fragments of late 12th to mid 13th-century waterfronts were found, all earlier than a structure dated by associated finds to the decade *c.* 1270–1280. A sampled honestone came from a deposition in this area, [2279], dated by pottery to the early 13th century or later, probably *c.* 1200–1240.

In the southeast corner of the site a fragment of late 14th- or early 15th-century timber revetment was uncovered. Its timber baseplate was dated by dendrochronology to 1394 or later. A sampled honestone was found in the foreshore which built up in front of this revetment, [2279]. Coins from the foreshore and the overlying dump suggest that the foreshore dates to the first quarter of the 15th century, there being none at all of the reign of Henry VI.

### Trig Lane, Upper Thames Street (TL74)

The first of the sampled honestones from the Trig Lane excavation came from the earliest excavated waterfront, G2, which must date to the late 13th century, probably *c.* 1260–80. The deposit, [2529], was part of a dump which contained little or no residual pottery and was probably therefore contemporary rubbish.

The second sample came from a deposit, [274], making up the dump behind a stone river wall, G15. This is apparently dated *c.* 1440 by dendrochronology and jettons. The associated pottery and tokens certainly date the deposit to the early 15th century or later. Like all the Trig Lane dumps, this deposit contained little residual material.

## CONCLUSION

Pottery and other dating evidence shows that these honestones come mainly from deposits of fresh rubbish used to make up the ground behind timber and stone river walls along the north bank of the Thames. The absence of appreciable quantities of earlier pottery suggests that redeposited earth was not present to any great extent and that the honestones were probably discarded shortly before burial.

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### NOTES

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