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Preface

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This thematic set of 16 papers relating to aspects of the Early Devonian Rhynie hot-spring system in Aberdeenshire arose from a conference on 'The Rhynie hot-spring system: Geology, Biota and Mineralisation' held at Aberdeen University in September 2003. The conference was hosted by the Rhynie Research Group in the Department of Geology and Petroleum Geology, and was sponsored by The Lyon Bequest to the University of Aberdeen, The University of Aberdeen, and Scottish Natural Heritage.

The conference brought together over 40 researchers with a variety of interests in ancient and modern hot-spring deposits, and particularly in the palaeontology of the Rhynie and Windyfield cherts. The conference programme comprised 20 talks and nine posters, together with demonstrations of bore-hole cores, examples of mineralisation and palaeontological material. A field excursion to Rhynie enabled delegates to examine the Rhynie chert *in situ* in a trench dug for continuing research, and timed to coincide with the conference. The last time any trenching had been done in the chert was 32 years ago in 1971. Abstracts from the conference are available at www.abdn.ac.uk/rhynie.

The first four papers in this set are related to history of research and the geological framework of the Rhynie area. Trewin reviews the history of research investigations in the Rhynie area, concentrating on events following the discovery of the Rhynie chert by Dr William Mackie in 1912. There have been several phases of geological exploration at Rhynie; the first initiated by trenching following Mackie's discovery, and culminating in the classic set of papers on the plants by Kidston & Lang (1917–1921). Further trenching in the period 1962–1971 heralded a second wave of publication, and drilling and trenching from 1989 to the present has provided further insights on the regional geology and mineralisation. New palaeontological finds followed the discovery of the Windyfield chert some 700 m from the classic Rhynie chert site. Building on data published by Rice *et al*. (1995, 2002), Rice & Ashcroft have combined a ground magnetic survey with extensive trenching to bedrock in the northern part of the Rhynie Basin. Following an analysis of newly-discovered fault and fold patterns, the basin is now interpreted as a pull-apart forming above a strike-slip system undergoing dextral shear. This interpretation provides an interesting explanation for the volcanism which is at the heart of the hot spring system. Using fluid inclusion and semi-quantitative mineralogical data, Baron *et al*. have examined vein and alteration assemblages in the hydrothermal system, and cements elsewhere in the basin. A variety of fluids are identified, including meteoric fluids of low to high salinity, and high temperature fluids interpreted as magmatic. Fayers & Trewin review the environments associated with the Windyfield chert, showing that the pods of fossiliferous chert formed close to vents in an area with subsurface hydrothermal alteration. The biota closely resembles that of the Rhynie chert, but it has also yielded the plant *Ventarura* (Powell *et al*. 2000), and several arthropods (Anderson & Trewin 2003; Fayers *et al*. in press).

The palaeontological papers provide new information on both the fauna and flora of the chert, and add several interesting new discoveries. When the discoveries reported here are combined with those recently published elsewhere (Taylor *et al*. 1999; Powell *et al*. 2000; Anderson & Trewin 2003; Fayers & Trewin 2003; Fayers *et al*. in press), it is clear that the terrestrial/freshwater biota preserved at Rhynie now has the greatest recorded biodiversity in the World for any site of comparable age.

New contributions to the fauna of the chert are provided by Dunlop *et al*., who describe remarkably well-preserved harvestman (opilionid) spiders from the chert. Trachaea and genital organs are preserved, the latter resulting in considerable press interest at the time of the conference. These are the oldest harvestmen known, and are remarkably similar to modern forms. More enigmatic is the small arthropod with an ovoid test described by Anderson *et al*., and interpreted as a benthic cladoceran. Habgood *et al*. provide a useful contribution on the variety of arthropod coprolites found in the chert. Coprolite contents show that detritivores were common in the Rhynie ecosystem, but there is little evidence for herbivory. Ross & York provide a list of the Rhynie hexapoda in the collections of The Natural History Museum. These include jaw structures named *Rhyniognatha*, and recently interpreted as belonging to an insect by Engel & Grimaldi (2004).

Studies of the flora commence with a review of the sporophyte plants by Edwards, noting the difficulties posed in the classification of some of the genera that possess simple architecture, but have complex and sophisticated internal structure. Such details allow interpretations of plant physiology, which in turn aid environmental reconstructions. Kerp *et al*. review the gametophyte generation of the plants and describe for the first time the gametophytes of *Rhynia*, named *Remyophyton*. The material allows the whole gametophyte plant to be described from germinating spore to sexual maturity. The male and female gametophytes for three of the Rhynie plants are now recorded. Wellman *et al*. describe the spores of *Horneophyton* on the basis of *in situ* material from sporangia; Wellman also presented an analysis of the dispersed spores in the Rhynie succession, now published as Wellman 2004. A full description of the charophyte alga *Palaeonitella* by Kelman *et al*. was made possible by the discovery of antheridia and gametangia; it is considered to be ancestral to the Nitelleae.

The fungi of the chert are reviewed by Taylor *et al*., who note the presence of several major taxonomic groups, and stress the importance of the chert in providing the oldest clear evidence of the interaction of fungi with macroplants and green algae. Examples of saprophytism, parasitism and mutualism are preserved in a complex ecosystem that clearly had a long development history prior to the Early Devonian.

The final three papers in the set relate to analogue studies on modern hot springs. Jones *et al*. review the problems associated with the identification of microbes in sinter, providing useful illustration of the preservational variety; Campbell *et al*. discuss the mineral transformations that take place in the maturation of sinter from opal-A to microcrystalline quartz in periods of less than 40 thousand years; and Channing & Edwards provide an elegant account of plant silicification experiments in a natural hot spring in Yellowstone National Park. Some of the textures and features seen are remarkably

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similar to some found in the Rhynie chert. These and other analogue studies (Trewin *et al*. 2004; Trewin & Wilson 2004) are providing useful information for the interpretation of the physical and chemical conditions that produced the superb preservation in the chert. However, there is much more to learn, and many questions remain unanswered with respect to the rapidity of silicification and preservation of detail in the Rhynie chert.

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