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DEVELOPMENT OF AN OHIO RADON WEB SITE

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ABSTRACT

The Ohio Radon Information System (ORIS) internet site at http://www.utoledo.edu/~aprg/oris/ is one of the most comprehensive sites on indoor radon available on the World Wide Web. It was developed by the authors under a research grant from the Ohio Department of Health and U.S. Environmental Protection Agency. It is estimated that from 700 to 1300 people die annually in Ohio from radon-induced lung cancer, and so the purpose of the site is to create awareness among Ohio's citizens of the radon problem and, by also providing information on methods of indoor radon reduction, to minimize the threat to their health.

The site is divided into the following nine sections: Information on Radon, Preventative Measures, Testing Procedures, Health Risks, Radon Concentrations Across Ohio, Lists of Radon Professionals, Other Sources of Information, Geology of Radon, and F.A.Q. (Frequently Asked Questions). The main strength of the site is the availability to users of large, interactive databases on Ohio's indoor radon levels and geology. Information from these databases is available for every county and most zip code areas within the state.

The authors have used advanced software tools, such as JAVA applets and CGI scripting, for displaying information and making the web site interactive.

INTRODUCTION

The Ohio Radon Information System (ORIS at http://www.utoledo.edu/~aprg/oris/) is one of the most comprehensive web sites for radon available on the World Wide Web. It was developed by the authors under a research grant from the Ohio Department of Health and U.S. Environmental Protection Agency. The site is primarily concerned with radon in the state of Ohio, but it also summarizes the results of radon research from throughout the U.S. It is estimated that 700 to 1300 Ohioans die annually from radon-induced lung cancer. The web site was developed to inform Ohio's citizens about the radon problem, and to assist them in making decisions about preventative and remedial measures. This paper provides a description of the web site and discusses the programming tools used to develop it.

WEB SITE ORGANIZATION

The web site is divided into nine sections. The contents of each of these are summarized below.

Information on Radon: This section provides answers to the fundamental questions about radon, such as what is it (Figure 1), where does it come from, how does it enter buildings, is it a problem for schools, is it in water, and how is it measured? Children are more susceptible than adults to the deleterious effects of radon and so the issue of radon in schools is discussed at length. Site users are told that the Ohio Department of Health will test public schools for radon without charge, and advises school administrators on ways to reduce radon levels.

Preventive Measures: Affordable measures are described for radon-resistant construction in new houses and remediation of existing houses. Included are methodologies for preventing radon entry with mechanical barriers, sub-slab depressurization (Figure 2) and water treatment, and for reducing indoor radon levels through maintenance of adequate indoor-outdoor ventilation and a positive pressure differential.

Testing Procedures: This section describes the many testing devices available for measuring radon levels inside buildings. Included are passive test devices that

homeowners can use themselves such as charcoal canisters and alpha-track detectors, and active test devices such as electronic continuous-radon and working-level monitors, and electret passive environmental radon monitors (E-PERM's) typically used by professional radon testers. Placement of these devices within buildings and interpretation of the results are also discussed.

Health Risks: The adverse effects of radon and its decay by-products on human health are described. The increased risks due to the combined, synergistic effects of smoking and radon inhalation are stressed, as is also the fact that there is no safe level of radon, only different degrees of risk (Table 1).

Radon Concentrations Across Ohio: This section makes available to users a database compiled by the authors that includes indoor radon levels for almost 82,000 buildings across Ohio, nearly all of which are private houses. Maps are provided that show the statewide distribution of average radon levels for both counties and postal zip code areas (Figure 4). Users can also obtain detailed statistics for radon levels in specific counties and zip code areas (Figure 3): median, and arithmetic and geometric means (all measures of average); and minimum and maximum, first and third quartiles, and standard deviation (all indicators of variations). The construction of and sources of information used for the database are described as are also the calculation procedures for the statistical parameters. To further enhance the features and utility of the web site, additional information on radon levels in schools and ground water is currently being developed and will be added in the near future. The database is also being upgraded with the addition of more indoor radon test results.

Lists of Radon Professionals: Up-to-date lists of Ohio-licensed radon mitigation specialists and contractors, and radon testers are provided. These lists are searchable alphabetically by city.

Other Sources of Information: This section provides a list of publications on radon and related topics, including many distributed by the U.S. Environmental Protection Agency. Links are also given to other radon sites on the World Wide Web.

Geology of Radon: Because radon comes from certain types of rocks, sediments and soils beneath buildings, indoor radon levels are, to a significant extent, controlled by geology (Harrell et al. 1993). This section describes the geologic controls on radon in Ohio and provides users with access to the authors' geology database. Included are maps

showing the statewide distribution of indoor radon levels superimposed on both the bedrock and glacial geology, and another map depicting the uranium levels in soils across Ohio (Figure 4). Users can also obtain detailed information on the bedrock and glacial geology of specific counties and zip code areas.

F.A.Q.: This final section of the web site answers the frequently asked questions about radon.

WEB SITE PROGRAMMING

Described below are the software and programming tools employed to create the databases and web site. Some of these tools were used for development while the others were used for data transfer (see Table 3).

Netscape Composer: HTML (Hyper Text Markup Language) was used to create all the pages on the site. Netscape Composer provides a convenient alternative to the time-consuming practice of directly programming the HTML code. To the user, this software functions much like a word processor but the text is automatically saved as HTML code when a file is created. For the subtle details on some pages, however, it was necessary to write the HTML code directly.

Microsoft Front Page: Like the Netscape Composer, this software also automatically creates HTML code from ordinary text, but Front Page is much more versatile in what it can do. Consequently, some of the web pages were created using this software.

Corel Web Graphics Suite: This software was used for drawing, editing and storing (in 'gif' or 'jpg' formats) some of the illustrations posted on the site.

Microsoft Image Composer: This software was used mainly for scanning in existing color illustrations and then adjusting their brightness and hue. It was also useful for creating some attractive visual effects such as adding shadows to images.

Adobe Photoshop: This software was used mainly for creating multi-layered images. For example, some of the original drawn and scanned illustrations have superimposed, independently editable layers with added colors, lines and texts.

Microsoft Excel: The spreadsheets for displaying information from the radon database were designed using this software.

JAVA: Two JAVA applets were written for the site. The first draws and displays (flashes) on a map the exact location of a user-selected zip code area or county. CGI scripting passes all the necessary parameters to this applet. The second applet produces a banner on one page that scrolls through the geometric mean radon concentrations for all the counties (Kumar and Kulkarni, 1999).

CGI Scripting: CGI scripting is used for searching and displaying the databases on the web. A flat file was created, through Personal Oracle, that contains all the necessary parameters. Whenever a user requests specific information from a database, such as data for a specific county or zip code area, CGI scripting queries the flat file for the parameters and then creates the web page with the retrieved data presented in a tabular form. CGI scripting also passes the necessary parameters to the JAVA applet, which then plots a map.

Personal Oracle: This is a very high-end database capable of running everything from the simplest one-table program to the most complex large-scale enterprise application. It was used to created four tables for the web site. Heydinger et al. (1991) and Kumar et al. (1998) give the details on the structure of tables and the associated codes.

Oracle Power Objects: The graphical user interface of ORIS was developed using this software. It includes all the tools necessary to create, modify and manage application components such as forms and reports.

WS FTP: The ORIS web site is hosted on the University of Toledo server. It is not possible to directly create or edit the HTML files on this server, and so another tool is needed to transfer the HTML files to and from the server. The work is nicely done by the File Transfer Protocol (FTP) available through this software. This product can be downloaded from the internet site at http://www.ipswitch.com.

CONCLUDING REMARKS

A web site on radon in Ohio has been developed and is now available to public. The site has been listed with numerous search engines to increase the public's access to it. The site is unique for including interactive databases that provide users with detailed information on the distribution of radon levels across Ohio and on the geologic factors controlling these levels.

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FIGURES AND TABLES

PICTORIAL REPRESENTATION OF RADON DECAY

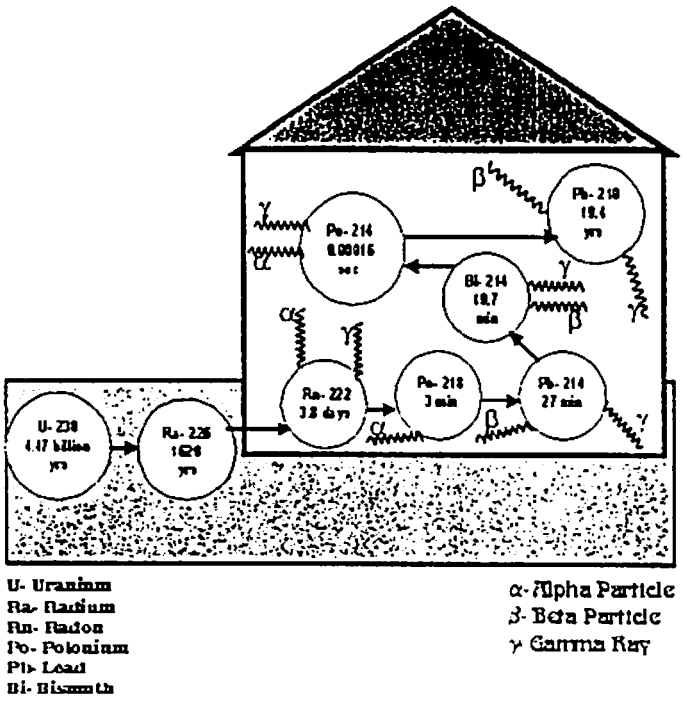


Figure 1. Radon decay products and their half- lives.

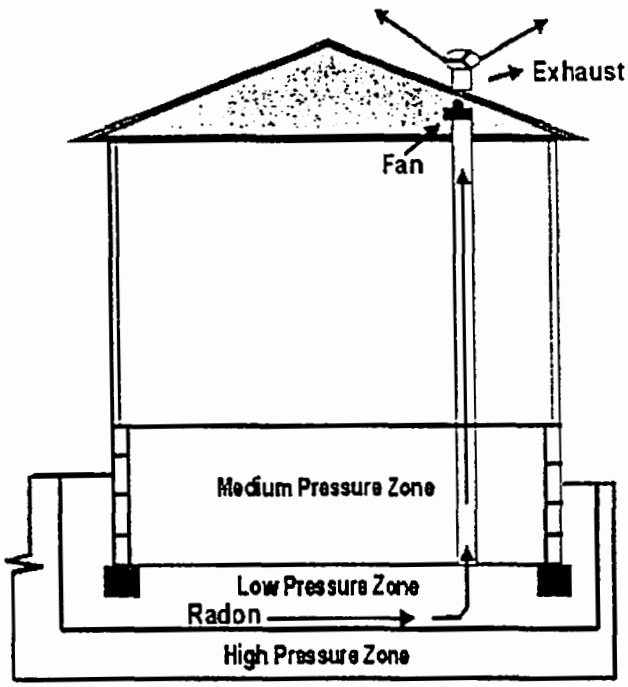
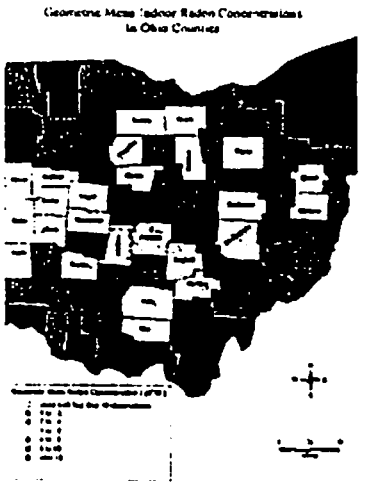
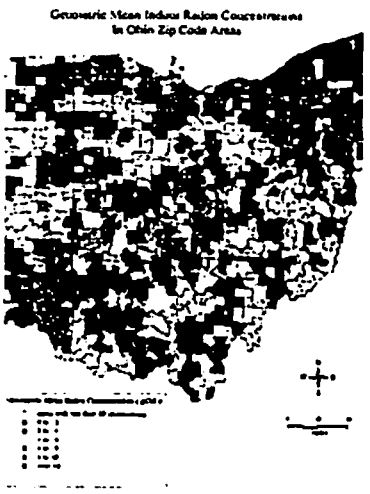


Figure 2. The sub-slab depressurization technique as a means of preventing radon's entry into a house.





AERIAL RADIOMETRIC MAP OF OHIO SHOWING THE CONCENTRATION OF URANIUM IN SURFICIAL SEDIMENTS AND SOILS (in parts per million)

Map 1 Map 2 Map 3

Figure 3. Examples of some of the maps posted on the site.

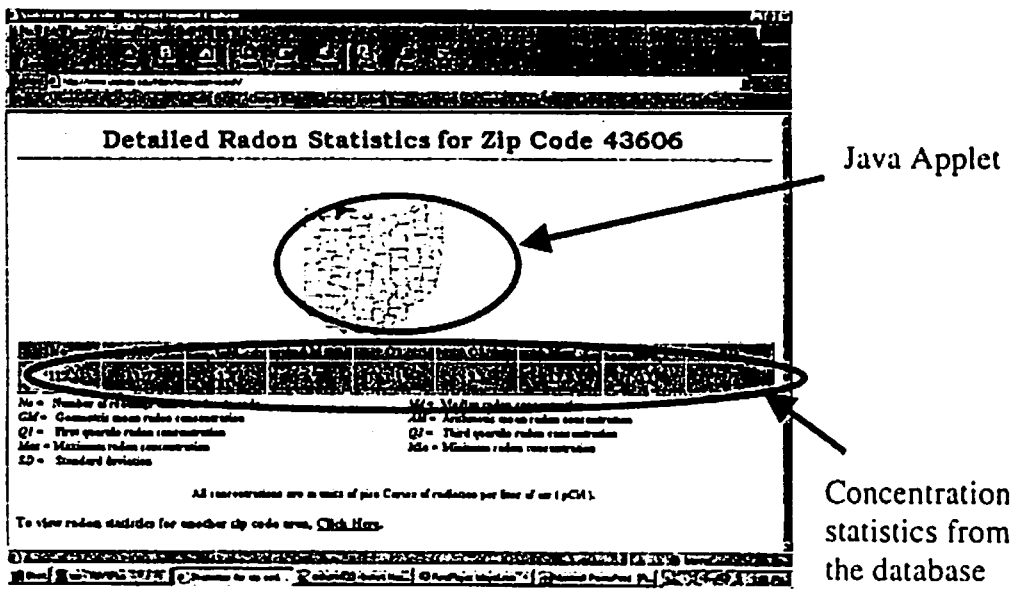


Figure 4. Example of a display utilizing a Java applet and the radon database for showing the radon concentration statistics and map for a zip code area.