Mine subsidence in Illinois: facts for the homeowner considering insurance

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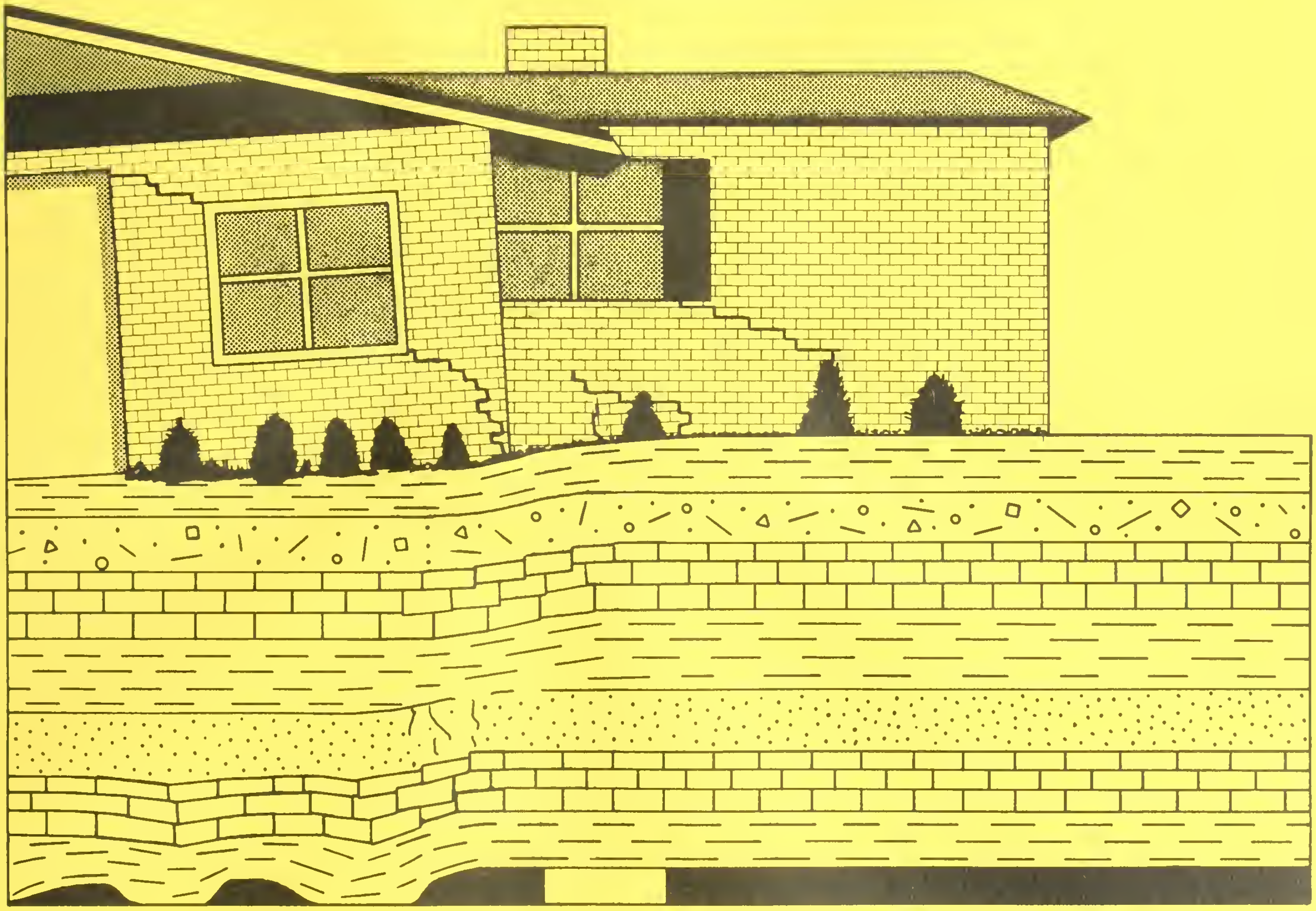

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ABSTRACT

About 750,000 acres of Illinois land have been undermined for coal, and many homeowners are concerned about the effects underground mining may have on their homes. Although subsidence of the surface above coal mines is not common, it does occur. Homeowners should be aware of any nearby mines and the causes and consequences of subsidence. They then can decide whether to insure their homes against possible damage.

INTRODUCTION

Subsidence is the sinking of land surface, commonly resulting from underground mining. In Illinois, property damage has been sufficiently severe that a state law was enacted to provide subsidence insurance for homeowners.

This publication has been prepared for homeowners in Illinois: (1) to inform them whether they live in subsidence-prone areas, (2) to aid them in understanding some frequently encountered effects of mine subsidence as well as problems sometimes mistaken for mine subsidence, and (3) to suggest further sources of information.

Although the new subsidence insurance program for homeowners in mining areas prompted the writing of this report, we do not attempt to explain the details of the insurance program. Our purpose is to explain the causes and the nature of subsidence and discuss ways to minimize damage caused by subsidence.

Indications of subsidence include the following:

1. Cracks suddenly appear in the foundation or walls and ceilings, then continue to grow, as do cracks in the ground.

2. Popping and cracking sounds are heard.

3. Doors and windows stick, jam, or break.

4. Sections of the house tilt and doors swing open/closed.

5. Water mains break, resulting in dirty tap water, loss of water pressure, and soaked ground.

If a case of subsidence is developing, several of these problems are likely to emerge within a period of a few days or weeks. If such incidents occur individually and randomly, however, they may indicate some other cause.

In order to understand the problems caused by subsidence, it is necessary to understand something about mining practices. Underground mines were developed in Illinois soon after the first settlers arrived. Because residents needed minerals to support their activities, they mined coal, lead, zinc, fluorite, claystone, and limestone (figs. 1 and 2). During the early years, land over mining areas was less populated. If the ground subsided, little damage resulted; as towns and cities expanded over mined-out areas, subsidence became a more serious problem.

Mine subsidence insurance in Illinois covers damage caused as a result of mining any mineral resource. Homeowners should be aware that subsidence is possible if any mineral has been mined in their area. This report emphasizes coal mining, however, because these mines underlie large areas of the state.

The total acreage of abandoned underground coal mines (fig. 1) far overshadows acreage undermined for all other commodities (fig. 2). In Illinois, 750,000 acres have been undermined for coal. Figure 3 indicates counties in which both underground and surface mining for coal have taken place. The counties shown with more than 1 percent of their land undermined have a subsidence insurance premium automatically included in homeowners' insurance policies. Some small areas undermined by individuals privately in the past are not shown on the map because records of such activities are sparse.

GENERAL GEOLOGICAL SETTING

Nearly all subsidence from underground mining in Illinois occurs over coal mines. In order to understand how and why such subsidence takes place, it is important to know what lies both above and below the mines. Failure of materials either above or below a mined-out area may cause the surface to subside.

The term "overburden" refers to all earth materials overlying the coal that is mined—surficial deposits of glacial origin as well as bedrock. Glacially derived materials range from less than 10 feet to more than 200 feet thick over the areas mined in Illinois. Although these materials exhibit a high degree of local variability, they are generally composed of an unstratified, unsorted pebbly silty clay material called till. Till may be interspersed with layers and lenses of sand, gravel, silt, and clay. In addition to till, a layer of windblown silt, called loess, blankets most of

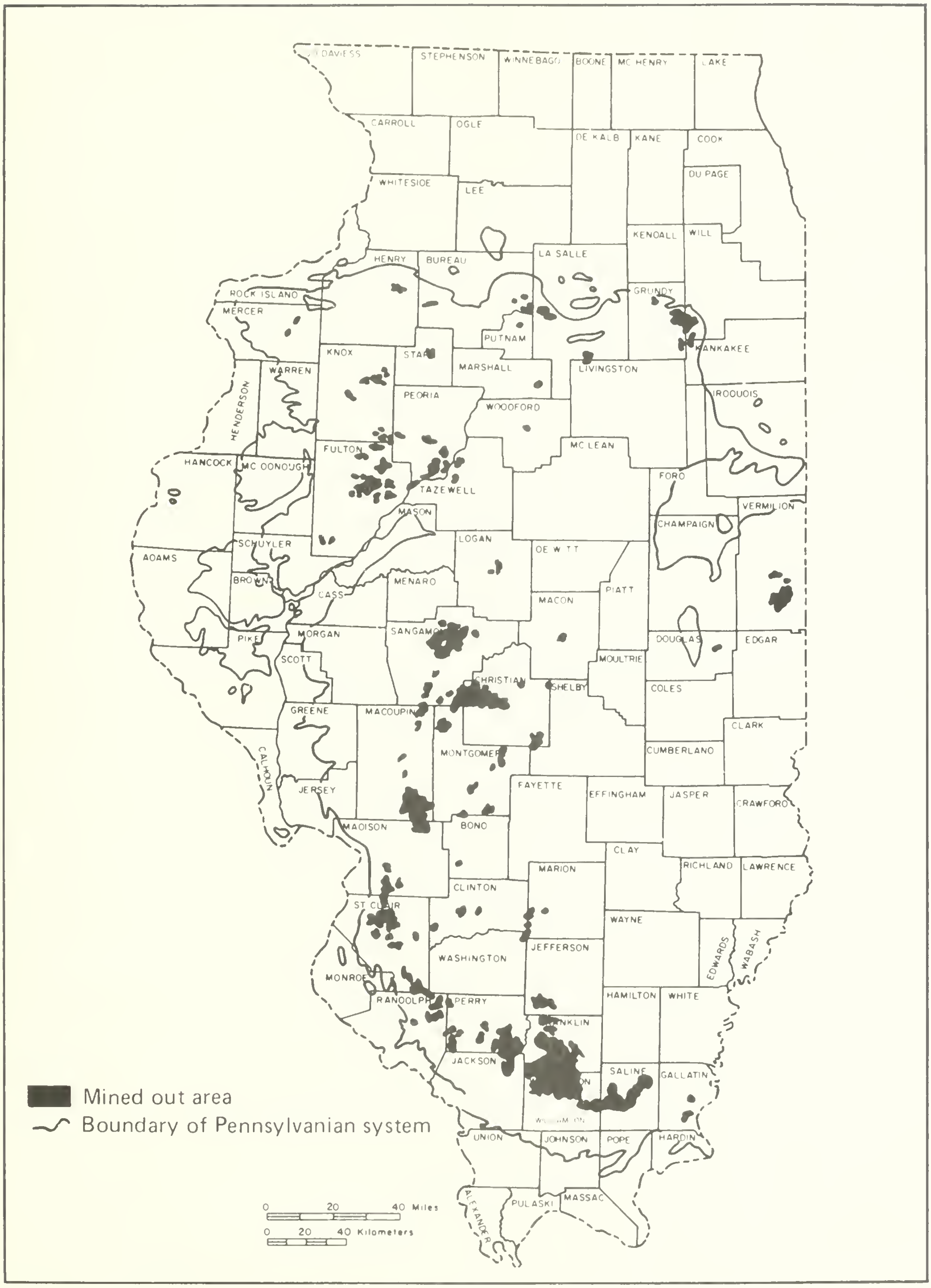


Figure 1. Areas of Illinois mined for coal (from ISGS/INR Document No. 80/10, 1980).

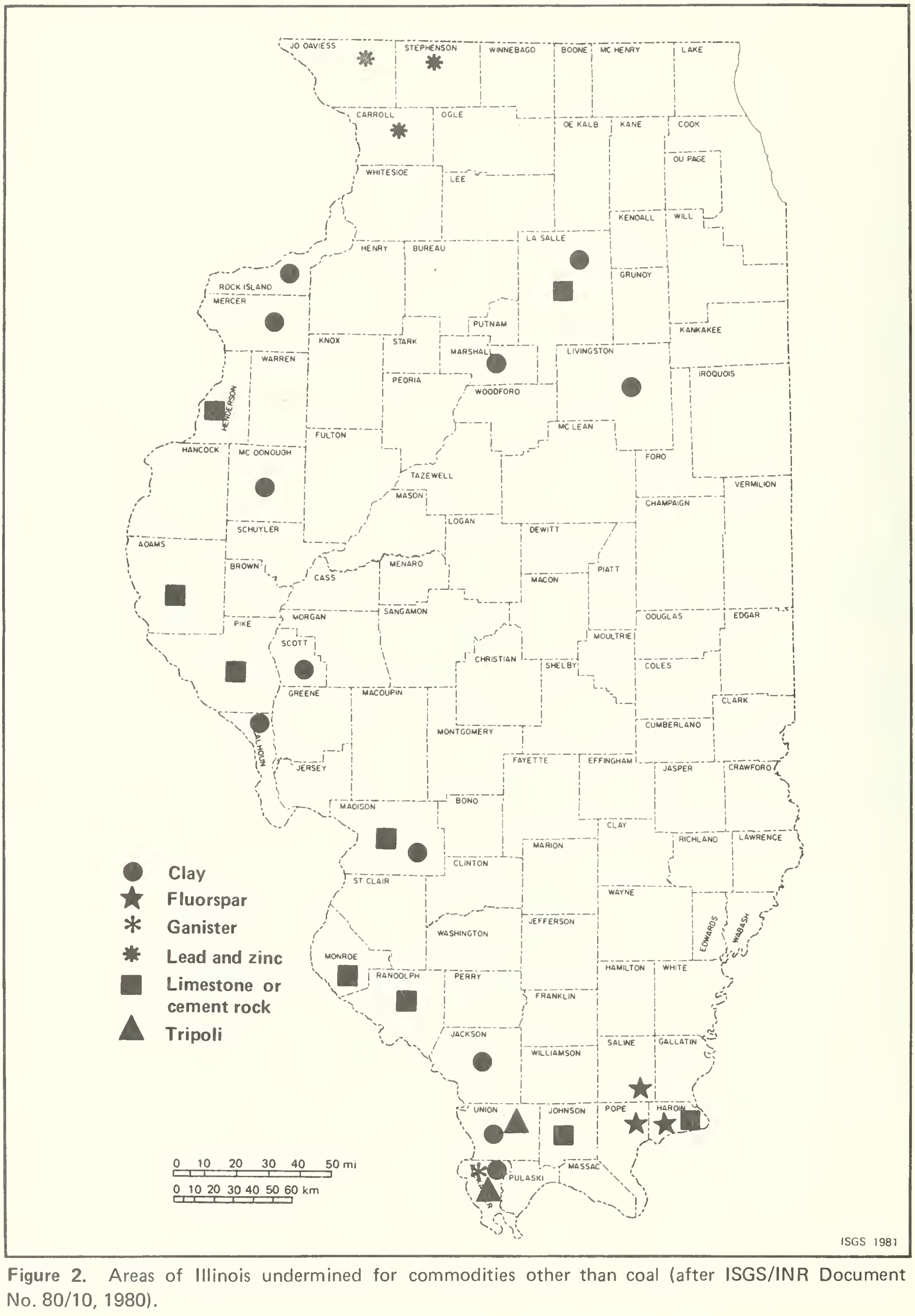


Figure 2. Areas of Illinois undermined for commodities other than coal (after ISGS/INR Document No. 80/10, 1980).

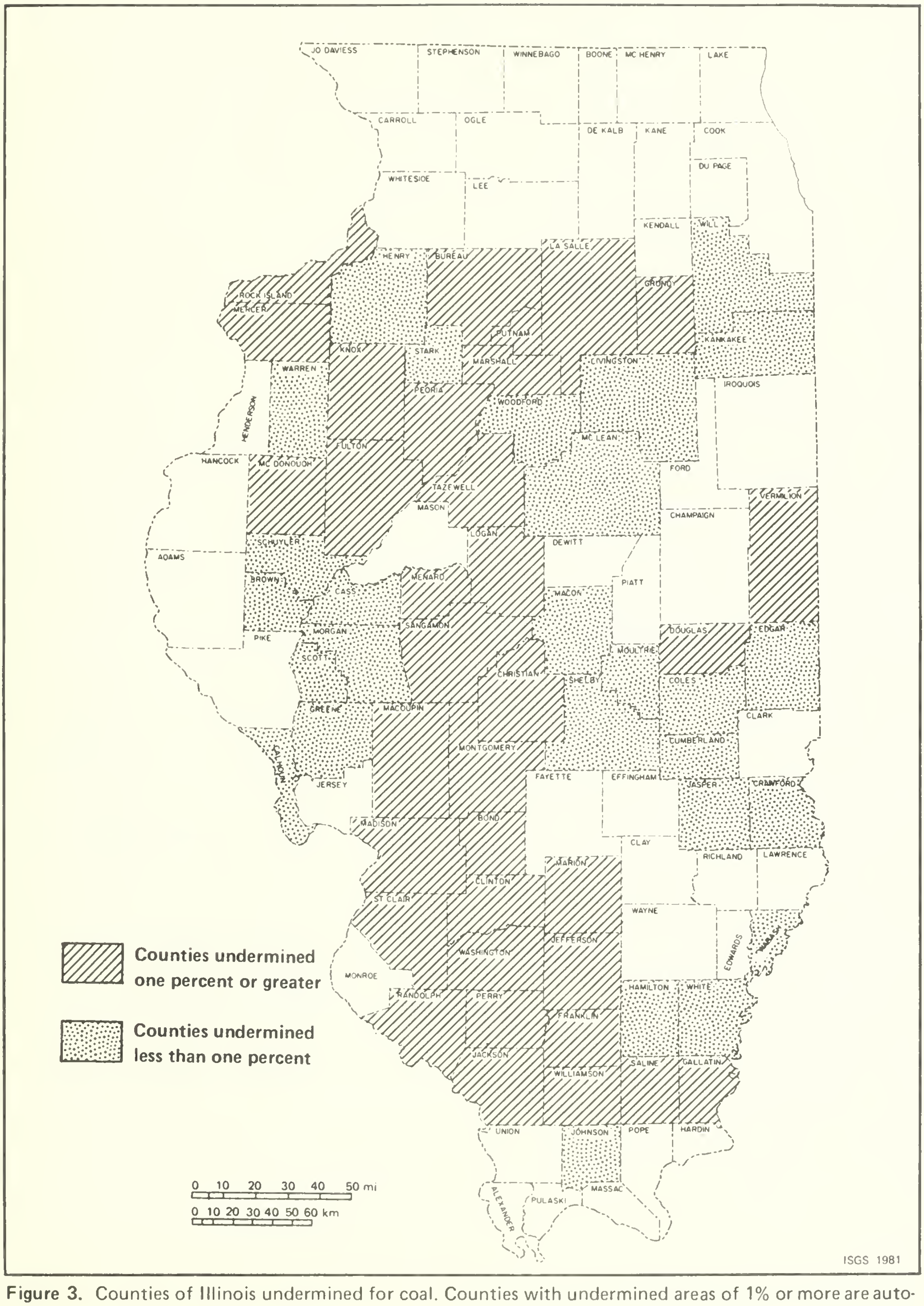


Figure 3. Counties of Illinois undermined for coal. Counties with undermined areas of 1% or more are automatically included in the mine subsidence insurance program. (After ISGS/INR Document No. 80/10,1980.)

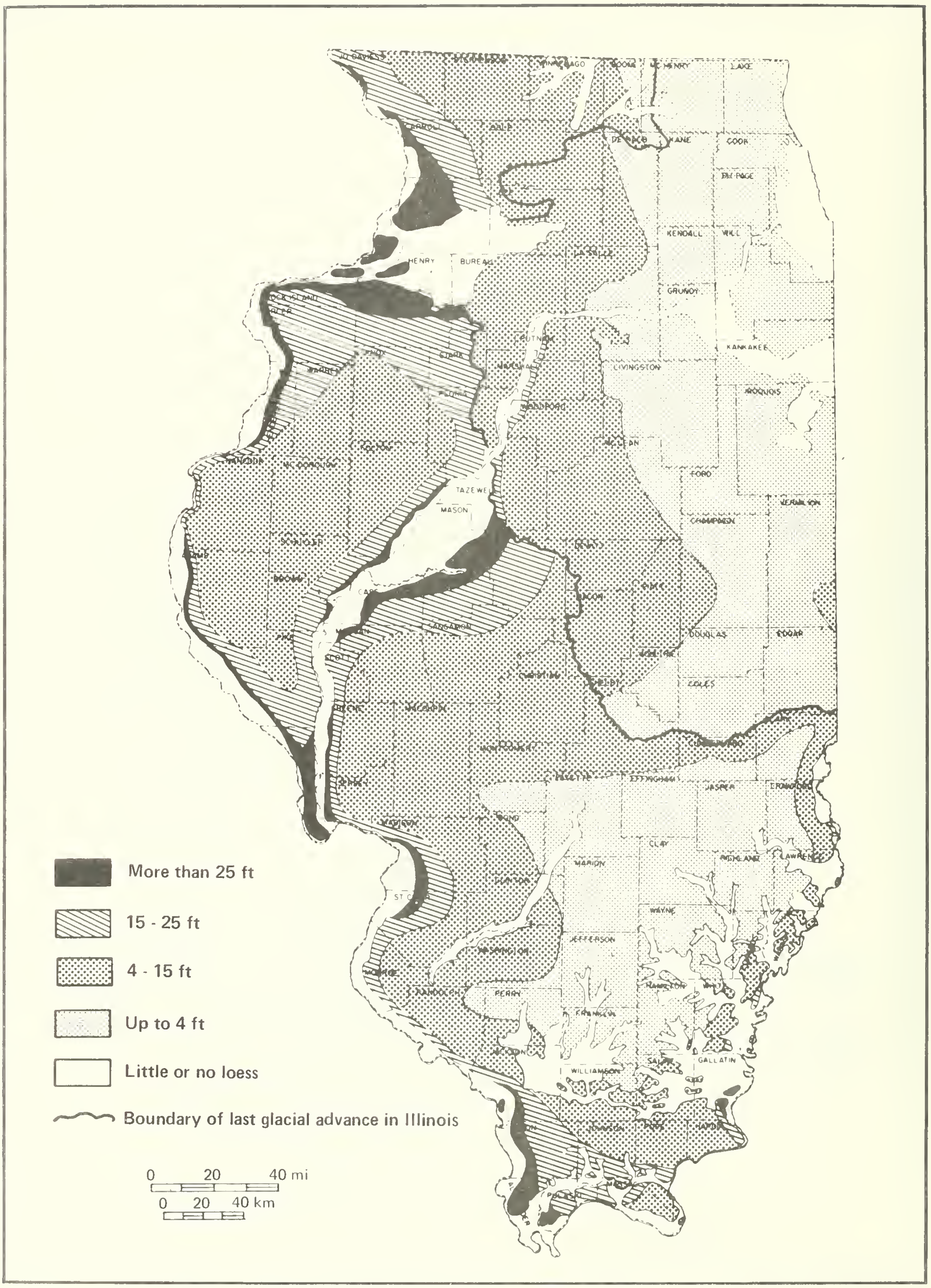


Figure 4. Thickness of loess in Illinois (Killey, 1975).

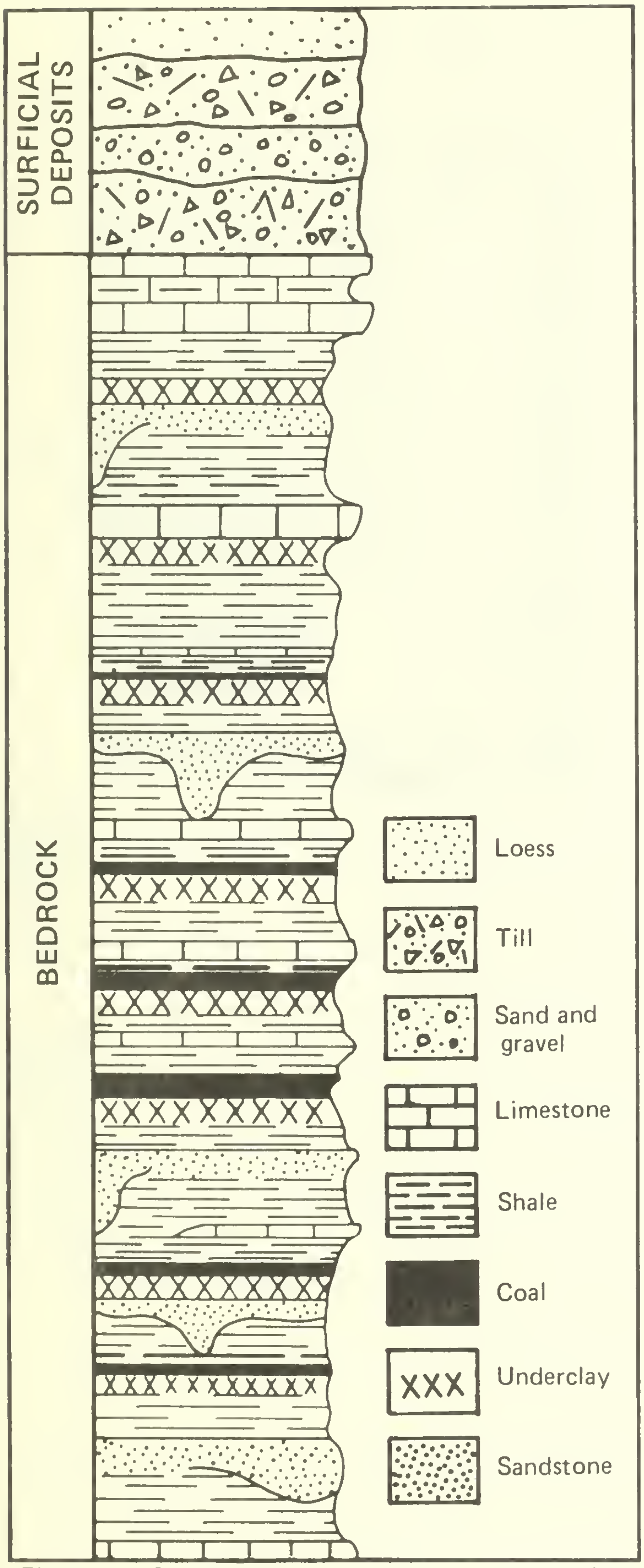


Figure 5. Generalized geologic column representing the layers of surficial deposits underlain by layers of bedrock which might be present in a typical undermined area.

the state, including coal mining areas. Loess ranges from less than 2 feet to approximately 25 feet thick (fig. 4), except for a portion of southwestern Illinois where it may attain a maximum thickness of nearly 100 feet. Beneath these surficial deposits is bedrock consisting of flat-lying or gently dipping sequences of shale, coal, claystone, limestone, and sandstone (fig. 5). The layer below most Illinois coals is a soft clay, called underclay. (The sections "Pit Subsidence" and "Sag or Trough Subsidence" discuss how the properties of the overburden and the underclay contribute to subsidence.)

Coal that lies close to the surface can be strip mined. Strip or surface mining accounts for almost half the current production in the state; however, much Illinois coal lies deep enough to require underground mining in the future.

MINING METHODS

Two fundamental types of underground mining methods have been used in Illinois: high extraction (including longwall) and room-and-pillar.

High extraction methods

High extraction methods (fig. 6) involve mining almost all the coal in a localized area. They always cause the surface above a mine to subside within several weeks after the mining is completed. Once it has been determined that subsidence has ceased, the land can usually be developed without further damage to buildings.

In early mines (fig. 6a), workers maintained the openings by leaving areas of stacked rock, wooden props,

Figure 6a. Early method (longface). Coal was removed from center (shaft) outwards along continuous perimeter. Voids were backfilled with rock for support (after Andros, 1914a).

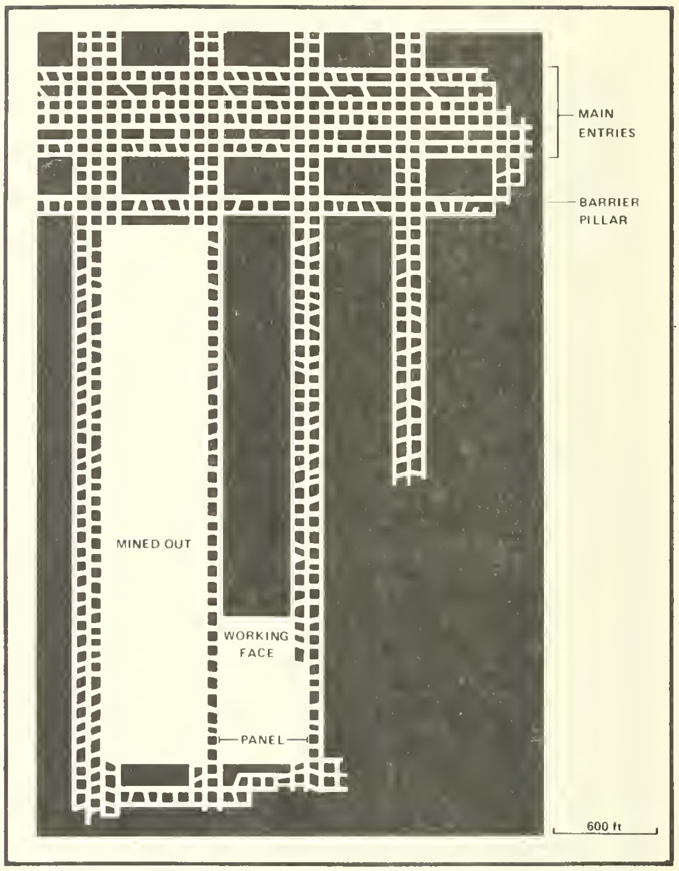


Figure 6b. Modern method. General development plan for high extraction retreat and longwall mining; see figs. 6c and 6d for details (after Hunt, 1980).

Figure 6. High extraction mining methods shown in plan views. Unmined coal is black; mined coal (void) is white.

and rock-filled cribs to replace the support lost by the removal of coal. The roof of the mine would settle onto the rock stacks, followed by the overlying bedrock and earth. This caused some subsidence at the ground surface. Modern high-extraction systems, however, are designed to achieve a high rate of production (figs. 6b, 6c, and 6d). Using the high extraction retreat method, workers remove as much coal as possible in a small area until the roof starts to collapse; then they retreat to another area. Using the longwall method, workers mine 100 percent of the coal along a straight working face; this causes the mine roof to collapse immediately behind the working face.

Room-and-pillar methods

Using the room-and-pillar system, a common alternative method, workers create openings (rooms) as they mine. Some coal is left for support (pillars). In Illinois, this system results in extraction of 40 to 75 percent of the coal.

The room-and-pillar method frequently used before the early 1900s was characterized by rooms that varied considerably in length, width, and sometimes direction (fig. 7a). To separate production areas (panels) from main entries (providing more support to the main entryways) and to improve ventilation, the modified room-and-pillar or panel system was developed (fig. 7b). This system provided a more regular configuration of production areas. The rooms and pillars were

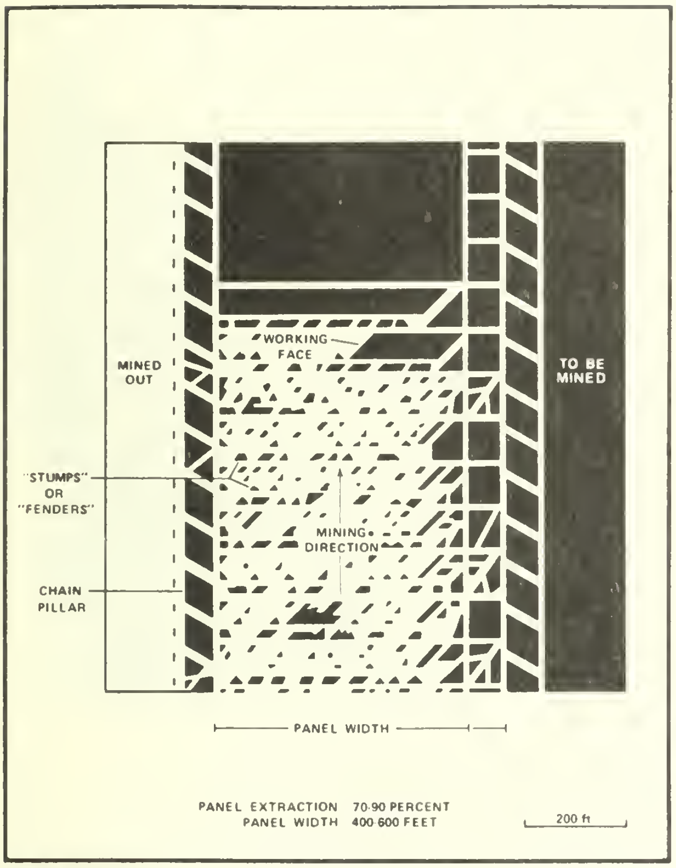


Figure 6c. Modern method (high extraction retreat). Small stumps of pillars are left for safety. Chain pillars may be mined to increase panel width (after Hunt, 1980).

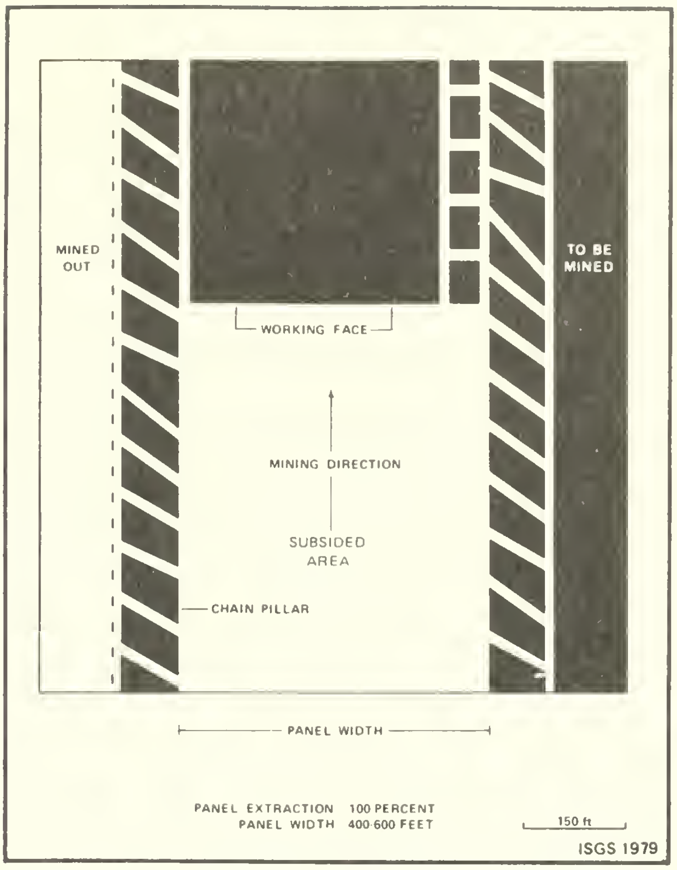


Figure 6d. Modern method (longwall). All coal is removed along a straight mining face forming a sharply defined panel with no remaining coal support (after Hunt, 1980).

Figure 6—*continued.*

set back from the main entries, and production areas (panels) had sharp boundaries resulting in broad barrier pillars (unmined areas between panels).

Two room-and-pillar methods are used currently: the blind room and the checkerboard (figs. 7c and 7d). Using the first method, workers leave every sixth or seventh room of a production area unmined (blind room), creating a large pillar to maintain roof support. The checkerboard system has evenly spaced square pillars in a checkerboard configuration. Under either system, modern mines have more main entries to provide for the increase in ventilation now required.

It cannot be predicted when—or if—the land above a room-and-pillar mine will sink. If any coal has been removed, subsidence will always be a possibility.

MINE MAPS

Illinois law requires mining companies to file maps and mining information with the State Mine Inspector, Department of Mines and Minerals, William O. Stratton Building, Springfield, Illinois 62706, and with the Office of the County Clerk in the county where the mine is located.

Because parts of some mine maps are only approximate representations, it may be difficult to correlate small areas of subsidence with specific rooms or parts

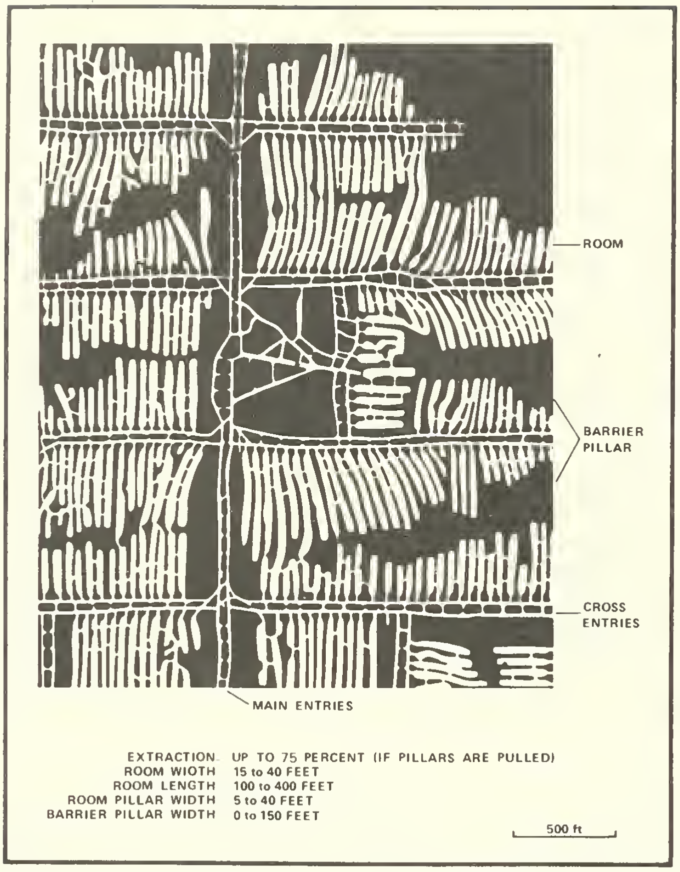


Figure 7a. Early method (basic). Irregular layout was typical of some early mines (after Andros, 1914b).

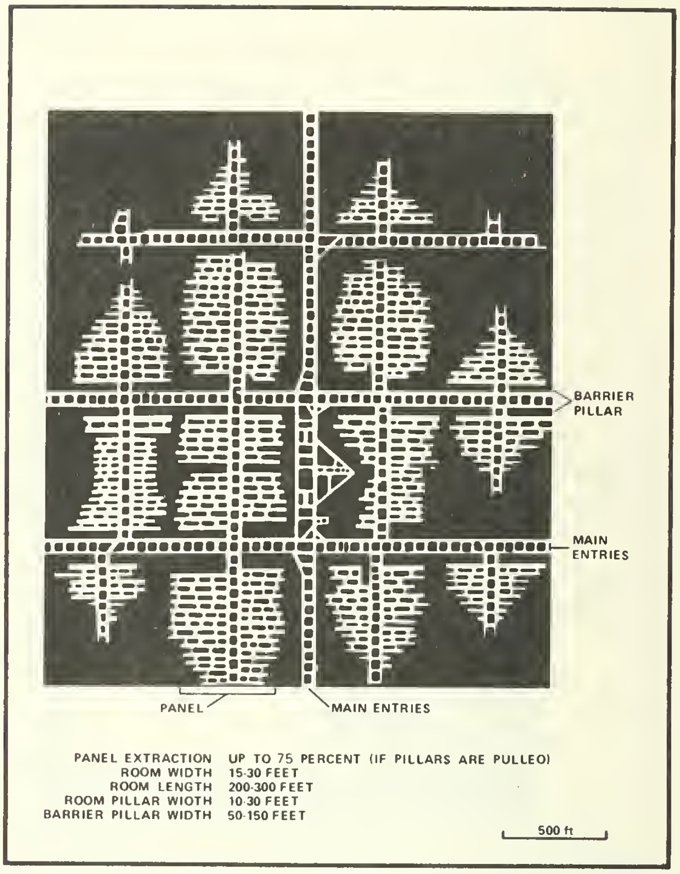


Figure 7b. Early method (modified). More regular layout of rooms and pillars; panels were separated from main entries (after Andros, 1914a).

Figure 7. Room-and-pillar mining methods shown in plan views. Unmined coal is black; mined coal (void) is white.

of production areas. The problem is further complicated because many old mines are partially collapsed or unstable, therefore inaccessible. Some are flooded with water, and some contain methane gas, carbon dioxide, carbon monoxide, and little or no oxygen. In places, the air in the mine may be explosive. Because abandoned mines are extremely dangerous for people to enter, approval and supervision must be obtained from the State Mine Inspector in order to enter them.

TYPES OF SUBSIDENCE

Researchers have learned much about the nature and causes of subsidence by studying incidents at the ground surface, drilling holes down to mines, lowering small television cameras down the holes to view mine conditions, and personally inspecting mines that are still accessible. In Illinois, subsidence of the land surface may take either of two typical forms: pit or sag (trough).

Pit subsidence

Pits are usually 6 to 8 feet deep (fig. 8) and may be 2 to 40 feet in diameter, although most are less than 16 feet across. Newly formed pits have steep sides with straight or bell-shaped walls. Pit subsidence usually occurs over mines

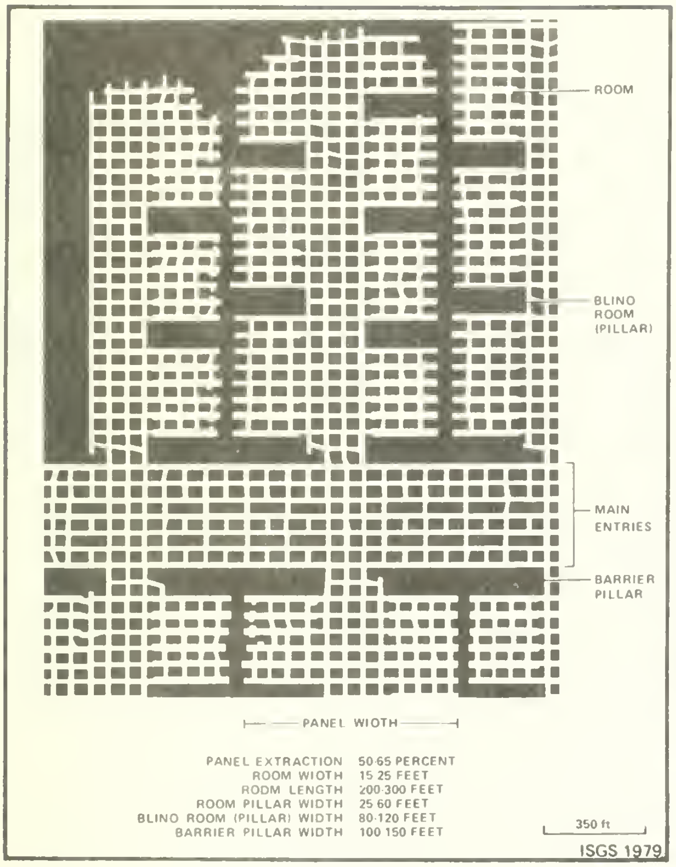


Figure 7c. Modern method (blind room). Every sixth or seventh room within a panel is left unmined (blind) for additional support of overburden (after Hunt, 1980).

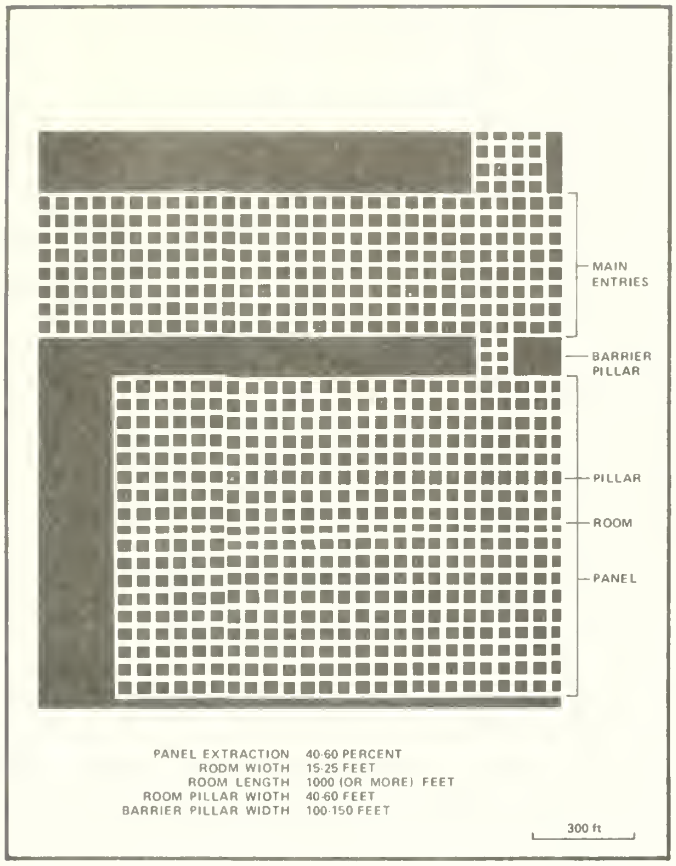


Figure 7d. Modern method (checkerboard). Evenly spaced large square pillars in a checkerboard configuration (after Hunt, 1980).

Figure 7—*continued.*

less than 165 feet deep. The mine roof collapses and the void works its way through the overlying bedrock and surficial deposits to the surface where a hole forms during a period of one or two days. If the bedrock is only a few feet thick and the surficial deposits are loose, these materials may subside and wash into adjacent mine voids in such a way that they produce a surface hole deeper than the collapsed height of the mine void.

Sag or trough subsidence

Sag subsidence forms a gentle depression over a broad area. Some sags may be as large as a whole mine panel—several hundred feet long and a few hundred feet wide (fig. 9). As a result, several acres of land may be affected. The maximum vertical settlement is usually 2 to 4 feet, as shown along the profile above the mine plan in figure 9. A major movement of sag subsidence may happen suddenly (in a few hours or days) or gradually (over years); figure 9 shows the settlement that took place over a 45-week period.

Sags may originate over places in the mines where the coal pillars have disintegrated and collapsed, or where the pillars have settled into the soft clay (underclay), which is the floor of most mines. Sags can develop over mines of any depth.

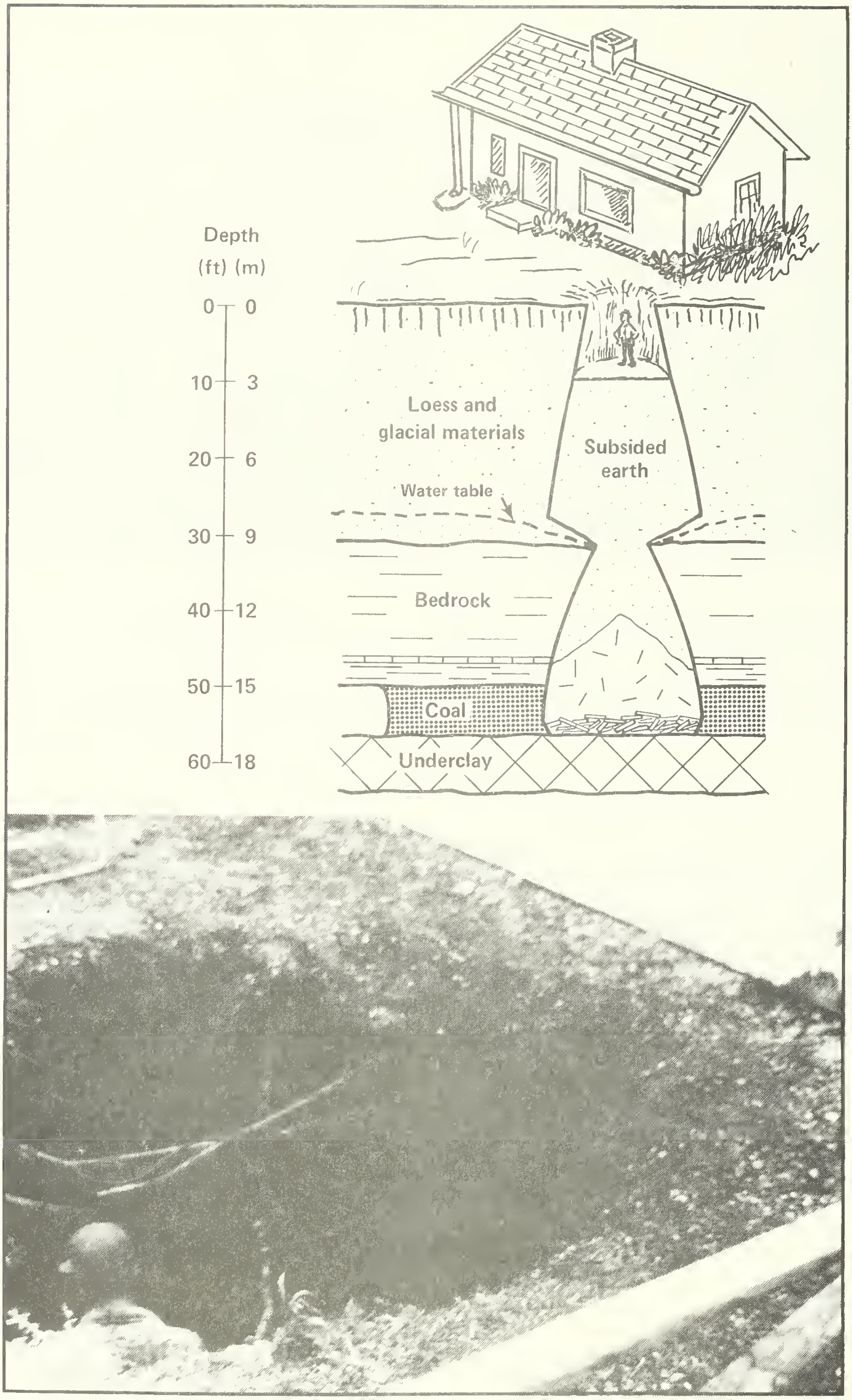


Figure 8. Cross section and photograph of a typical pit subsidence event (after Wildanger et al., 1980).

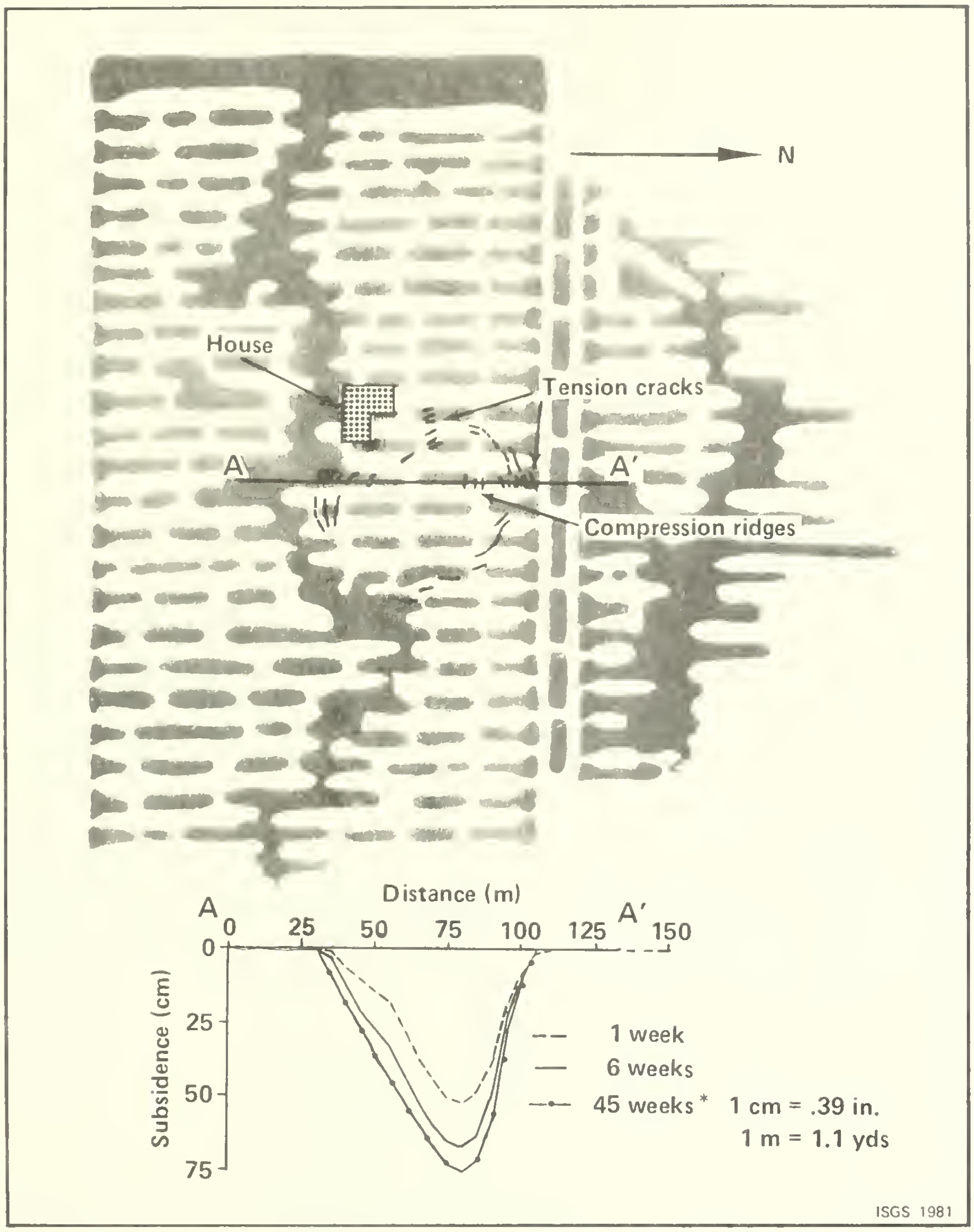
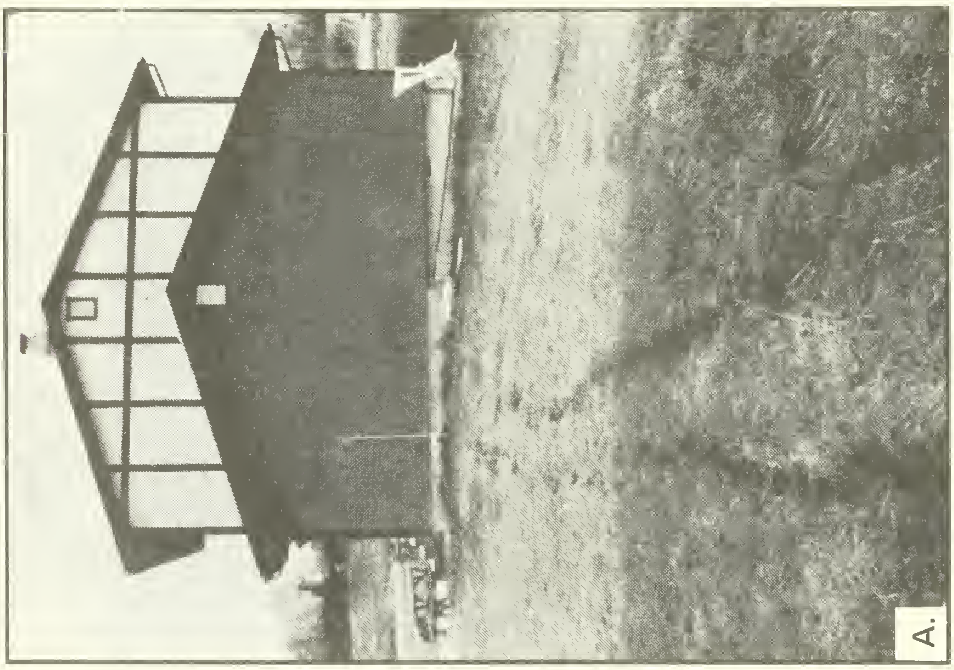


Figure 9. Compression ridges and tension cracks of a sag subsidence event shown on a map of the underlying mine. Profile A—A′ shows the development of the sag over a period of 45 weeks. Compression ridges formed near the deepest part of the sag, and tension cracks formed around the perimeter of the sag. (*Data from Dave Kiesling, Department of Engineering, University of Illinois, personal communication, 1981.)

Tension cracks form as the ground is pulled apart. Generally, they parallel the boundaries of the depression. Compression ridges form as the ground is squeezed. Although ridges are observed less frequently than tension fractures, they are usually found in the deepest part of the sag (figs. 9 and 10).

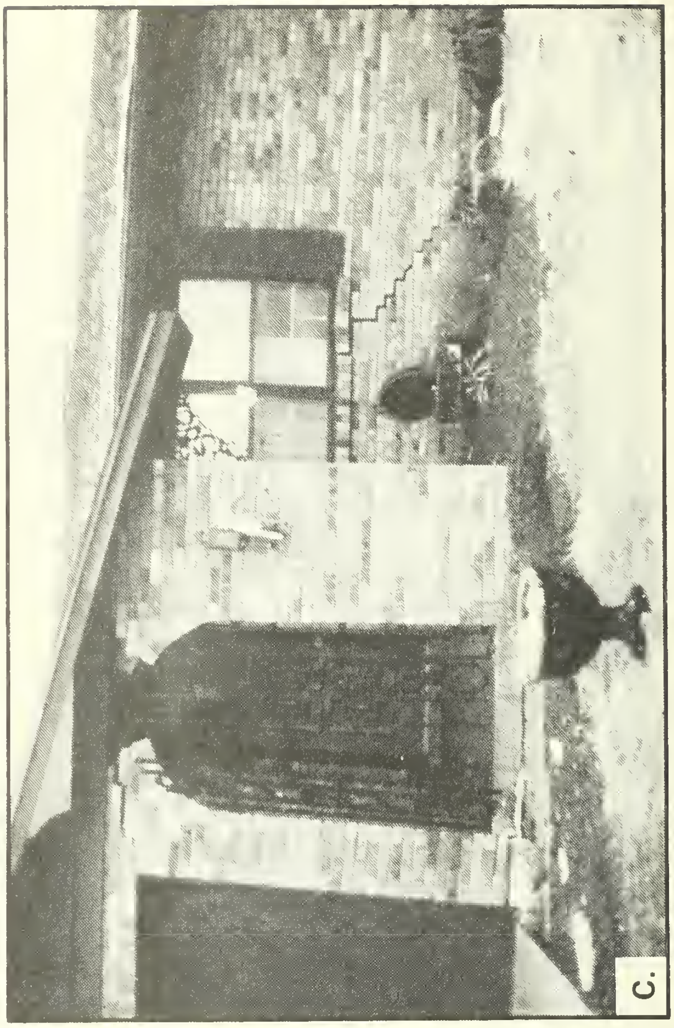
EFFECTS OF SUBSIDENCE: PROBLEMS AND SOLUTIONS

Pit subsidence causes only one direction of movement in the ground—vertical drop. The development of pits at the surface is most common after heavy



A.

B.



C.

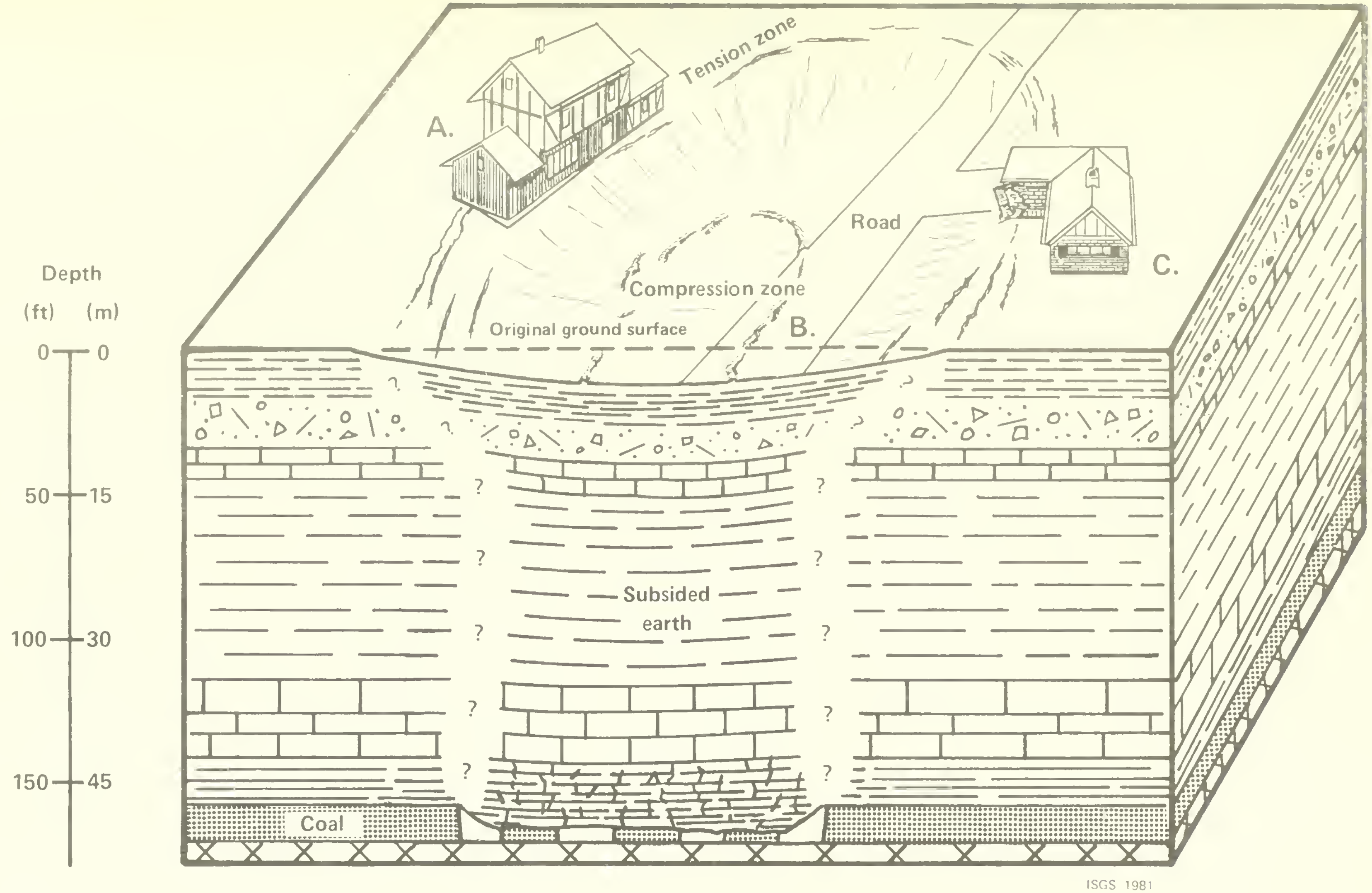


Figure 10. Block diagram of a typical sag subsidence event:

A. Wooden frame house in tension zone. Foundation has pulled apart and dropped away from the superstructure in one corner.

B. Road in compression zone. Asphalt has buckled.

C. Brick house in tension zone. Walls, ceilings, and floors have cracked.

rainfalls. Water does not usually accumulate in pits but drains down into the mine. A practical suggestion provided by engineers is to fill the pits with sand and cap the fill with clayey materials. Sand settles little, and the clay cap would reduce the amount of water that could flow into the mines to cause more problems. Unless filled with material that is compressible (such as organic rubble), most pits do not become deeper once they have initially subsided. The few that do deepen usually subside a few inches per year.

Structures can be damaged if pit subsidence develops under critical areas, such as the corner of a building or foundation support posts. However, the chances of a structure being damaged by pit subsidence are low because most pits are relatively small (only a few feet across). In fact, if pit subsidence develops under the foundation walls of a house, it may not damage the house immediately because the foundation will form a temporary "bridge" over the pit (fig. 8); however, the "bridge" will eventually become damaged.

Homeowners living in an area where pit subsidence is common should periodically inspect crawl spaces and other hidden areas of their homes. A pit should be carefully filled so that proper support is again established beneath the foundation.

Sag subsidence causes two directions of movement in the ground—vertical drop and horizontal movement toward the center of the sag (fig. 10). The sag at the surface may be much broader than the collapsed portion of the mine. For example, a failure in a mine 160 feet deep could cause surface subsidence more than 75 feet beyond the edge of the undermined area. (Deeper mines would affect even larger areas.) In the tension zone, large cracks in the ground may develop and result in damage to structures in this area. In the comparatively smaller compression zone, roads (B) may buckle and foundation walls may be pushed inward. The type and extent of damage depend on the orientation and position of a structure within a sag.

Houses A and C, for example, may exhibit cracking and separation caused by tension throughout the house. House C will need to be entirely supported. Damage in House A will be restricted mostly to the cantilevered side, so that only this side will need to be supported. The road shows both cracks in the tension zone and buckling in the compression zone. If there were a house in the compression area, its foundation would be under horizontal compression. Because compression is likely to inflict less damage than tension, any building in the area should need little more than releveling.

Repair of houses damaged by subsidence

A house is usually built on a slab, crawl space, or basement. Each construction type must be treated differently once an area subsides. The repair of most structures requires detaching the house from the slab or foundation to relieve stress and to allow for releveling. In houses or buildings that have not been releveled, failure of windows, sticking of windows and doors, leaks in the plumbing, and other problems have been known to occur months after the initial subsidence event.

The releveling technique for each house is unique because the construction of and access to each structure is different.

■ houses with slabs

Some frame houses are supported by broad, flat concrete pads called slabs. These houses are usually attached to the slabs, and if subsidence takes place and the slab settles, the house will be pulled downward. Restoring such a house to a level condition may require detaching the house from the slab and jacking up the frame. Bolts that hold the frame to the slab can be difficult to find and remove because they are located within the walls. Support and jacking must be done on the bearing walls because the typically constructed slab cannot be jacked up without causing severe damage. After the house is raised, the interior is exposed to the outside where the walls leave the floor (fig. 11), a situation that will present serious problems to the owner until a new level floor is put in. One should not grade and pour a new floor until the subsidence and settling of the ground ends, which may be a year or more. Measurements of the cracks can be taken periodically to determine when movement has ceased.

■ houses with crawl spaces

Other frame houses are supported by perimeter footings with foundation walls (and interior piers when necessary) making a crawl space between the floor and the ground surface. Bolts attaching the foundation to the wooden frame in such houses are generally accessible. Once the house is detached from its frame, supporting beams can be inserted under the house, and it can be jacked to a level position. Blocks from the walls of the crawl space are

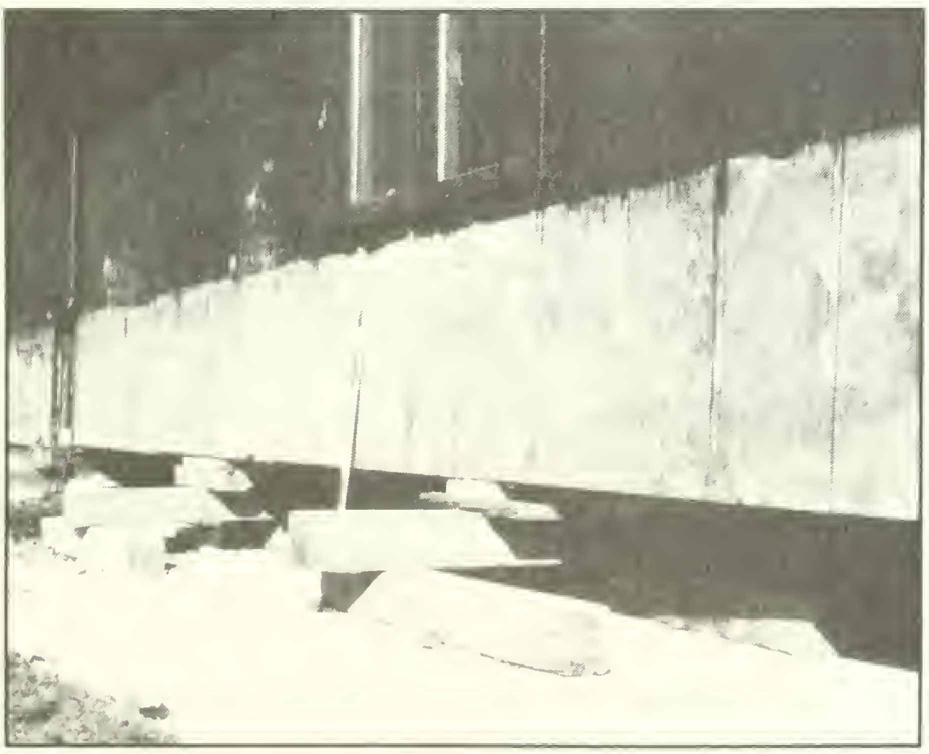


Figure 11. Bearing walls of a house on a slab foundation. The entire superstructure has been jacked up to a level position, exposing the interior.

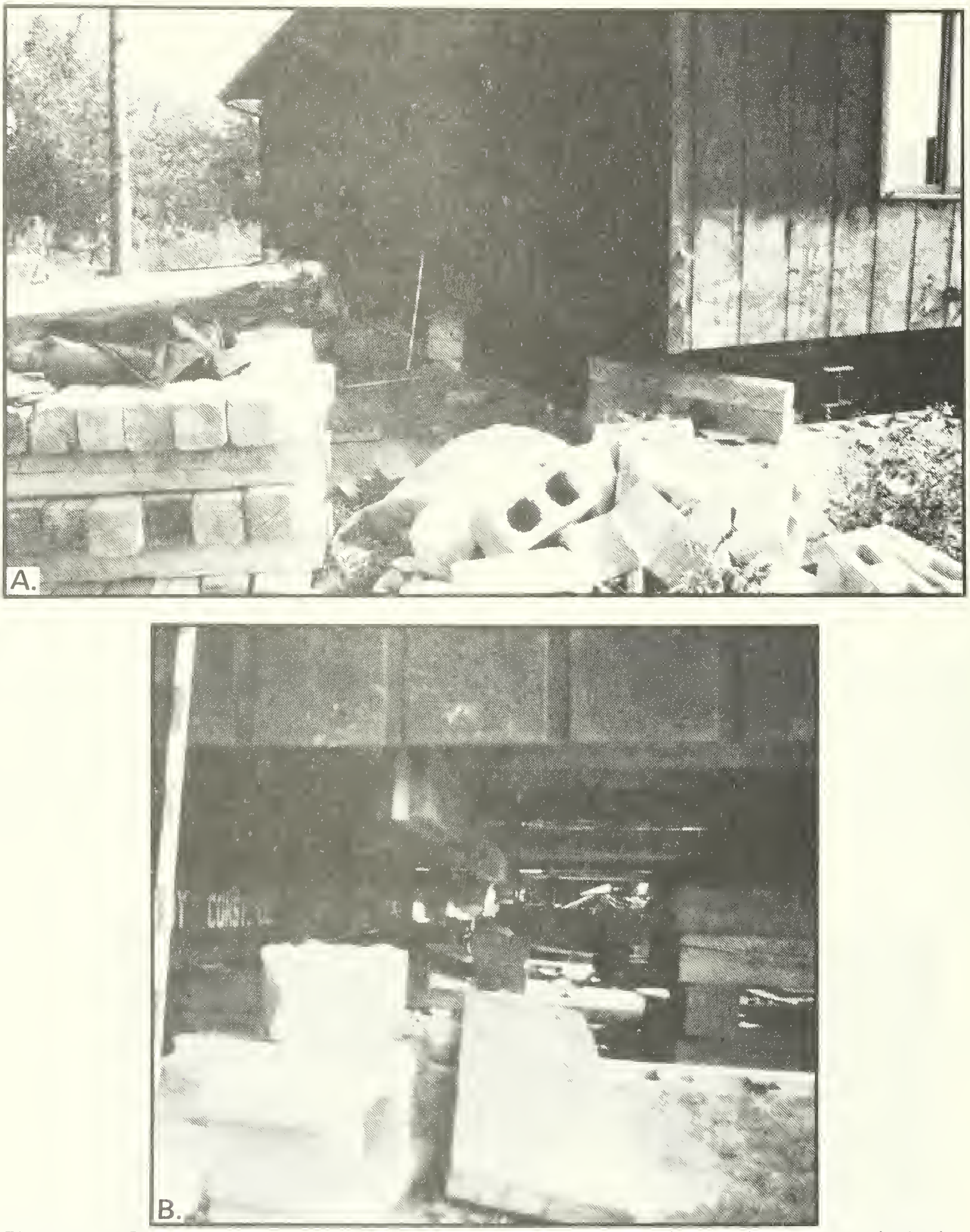


Figure 12. Cinder blocks of a crawl space have been removed to make room to jack the house to a level position (A). A closer view of the crawl space shows the I-beams supporting the releveled house (B).

easily removed so that the beams can be inserted (fig. 12). The family can continue to occupy the house because the floor is jacked up with the frame.

■ houses with basements

In other frame houses, support is provided by basement walls and interior piers with posts where necessary. Subsidence in such houses may cause cracks to form in the walls and floors of basements, and in areas where the water table is high, basements may flood with water. Some basements with poured concrete walls may present special problems. For example, basement windows may not allow sufficient room or be properly located for bringing support beams from the outside and positioning them. Breaking through basement walls can be time-consuming, difficult, and costly. Where the basement walls are constructed of cinder blocks, the supporting and releveling of a house follows the same procedure as that discussed for a house with a crawl space. In any case, basements allow room for access so that individual solutions can be devised for each house.

■ brick houses

Houses built of brick or other masonry need undergo only small movements before they show cracks that may render the entire structure unstable. A brick structure, unlike a wooden frame, generally cannot cantilever over a subsided foundation. Expensive remedial measures may be necessary to develop suitable support for these heavy structures.

Effects on utilities and the ground

The subsidence responsible for damaging foundations is also responsible for broken water mains, water lines, gas lines, sewer lines, telephone lines, and electrical wires. Although gas leaks are the greatest hazard because an explosion can occur, leaks from broken water mains are often the first noticeable evidence of major subsidence. Leaking water or sewer pipes may saturate the ground around a foundation or wash soil from under the house, especially in areas with moisture-sensitive soils. If utility poles tilt or sink, power and other lines can sag or pull from the poles. In turn, this may expose electrical wires, creating another hazard.

Ponding of water can take place in a sag (fig. 13). If any part of a house is in a sag, the area under the house should be kept dry. Also, the ground surrounding the foundation must be well drained because excess moisture can cause additional foundation-bearing problems.

Pit subsidence poses a special danger for both people and animals. Pits are often deep with steep sides, and anyone who falls in may find it very difficult to get out, even if he is not injured.

CONDITIONS THAT MAY BE MISTAKEN FOR MINE SUBSIDENCE

Other circumstances produce similar types of damage that may be mistakenly attributed to mine subsidence. If your house has any of the problems listed on page one, they may be caused by one or more of the following conditions.

Swelling and shrinking of moisture-sensitive soils

Moisture-sensitive soils expand when wet and create pressure that can push foundation walls inward. As the walls press in, the floor of the house drops and becomes tilted (fig. 14a).

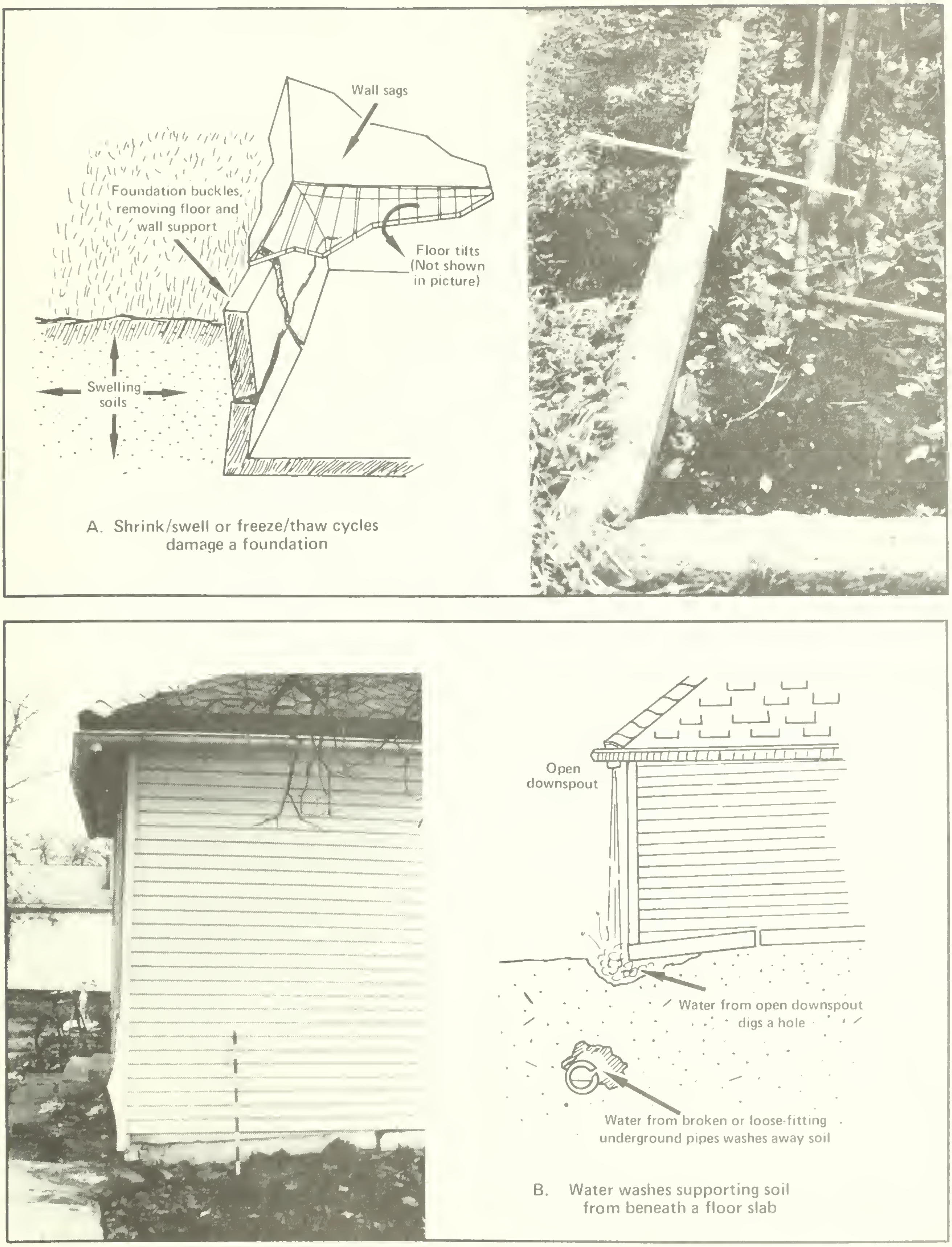
Figure 13. Water forming a pond in a sag subsidence.

Loss of bearing support can also cause foundations to tilt or sink (fig. 14b). To avoid these problems, keep water away from foundation walls. Dirt should be built up to create a slope away from the foundation, and downspouts should discharge water several feet away from the house.

Trees or large shrubs growing near foundations tend to alter soil moisture conditions. They can significantly lower the water content of the soil. During a drought, plants may absorb so much of the available water that the soil shrinks from lack of moisture. Evaporation aggravates this problem. When the soil shrinks, it releases pressure on foundation walls, allowing them to sink or tilt outwards. Removing large plants during periods of normal or excessive moisture can also damage foundations. The water that plants normally would have absorbed swells the soil and produces excessive pressure on foundation walls.

Freezing and thawing of soils

Poorly drained fine-grained soils undergoing freezing and thawing will expand and contract in a manner similar to moisture-sensitive soils (fig. 14a). Proper drainage through the use of granular materials (sand, for example) can reduce the potential for frost heave. These materials should be used beneath unheated outbuildings, driveways, retaining walls, and other structures that are most likely to be affected.



A. Shrink/swell or freeze/thaw cycles damage a foundation

B. Water washes supporting soil from beneath a floor slab

Figure 14. Examples of damage that may be mistaken for mine subsidence.

Piping

Piping (subsurface erosion by water washing away fine-grained soil) can occur along broken or separated sewer lines, water lines, and downspouts (fig. 14b). When the sewer line is carrying a high flow, water will flow out of the broken pipe, saturating the soil. When a sewer line flow is low, water in the saturated soil flows back into the pipe and carries soil with it. This movement excavates a cavity around the sewer line. The cavity may become large enough to reach the surface, where a hole appears. Piping into a sewer line takes several years, and the ground may sink or collapse, forming depressions that have been mistaken for mine subsidence.

Poor intermediate supports for main beam of house

Supports can sink if they do not rest on poured concrete footings, if footings are not below the annual frostline, or if footings are too small. In addition, an inadequate contact area between a beam and a support may concentrate enough weight onto the beam to crush it, thus lowering the floor. Poor construction or an insufficient number of floor joists can cause large sags in floors, which can be mistaken for subsidence.

INFORMATION FOR HOMEOWNERS CONSIDERING MINE SUBSIDENCE INSURANCE

Homeowners who wish to be protected should purchase mine subsidence insurance if their property is above or near an undermined area or an area soon to be mined. Your insurance agent can describe the mine subsidence insurance program to you and indicate the coverage that is available. If you live in one of the 34 counties with more than one percent of the land undermined (fig. 3), subsidence insurance will automatically be added to your homeowners' policy when it is renewed. You will be asked to sign a waiver if you refuse coverage.

The county clerk's office is a good place to learn about all local mining activities. The Illinois Department of Mines and Minerals, 400 South Spring Street, Springfield, IL 62706, may also be of assistance. Additional information as well as maps showing areas where coal has been mined in Illinois can be obtained from the Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820. Figure 15 shows parts of the state covered by mined-out coal area maps. Other types of mining are not shown on these maps.

WHAT HOMEOWNERS SHOULD DO IF SUBSIDENCE OCCURS

Assistance is available. If you are insured, call your agent immediately. He will look over your house, and he may call in a regional adjustor to help you with your claim.

If you are not insured, contact the Illinois Mine Subsidence Rapid Response Team (Director, Abandoned Mined Lands Reclamation Council, 311 North Second

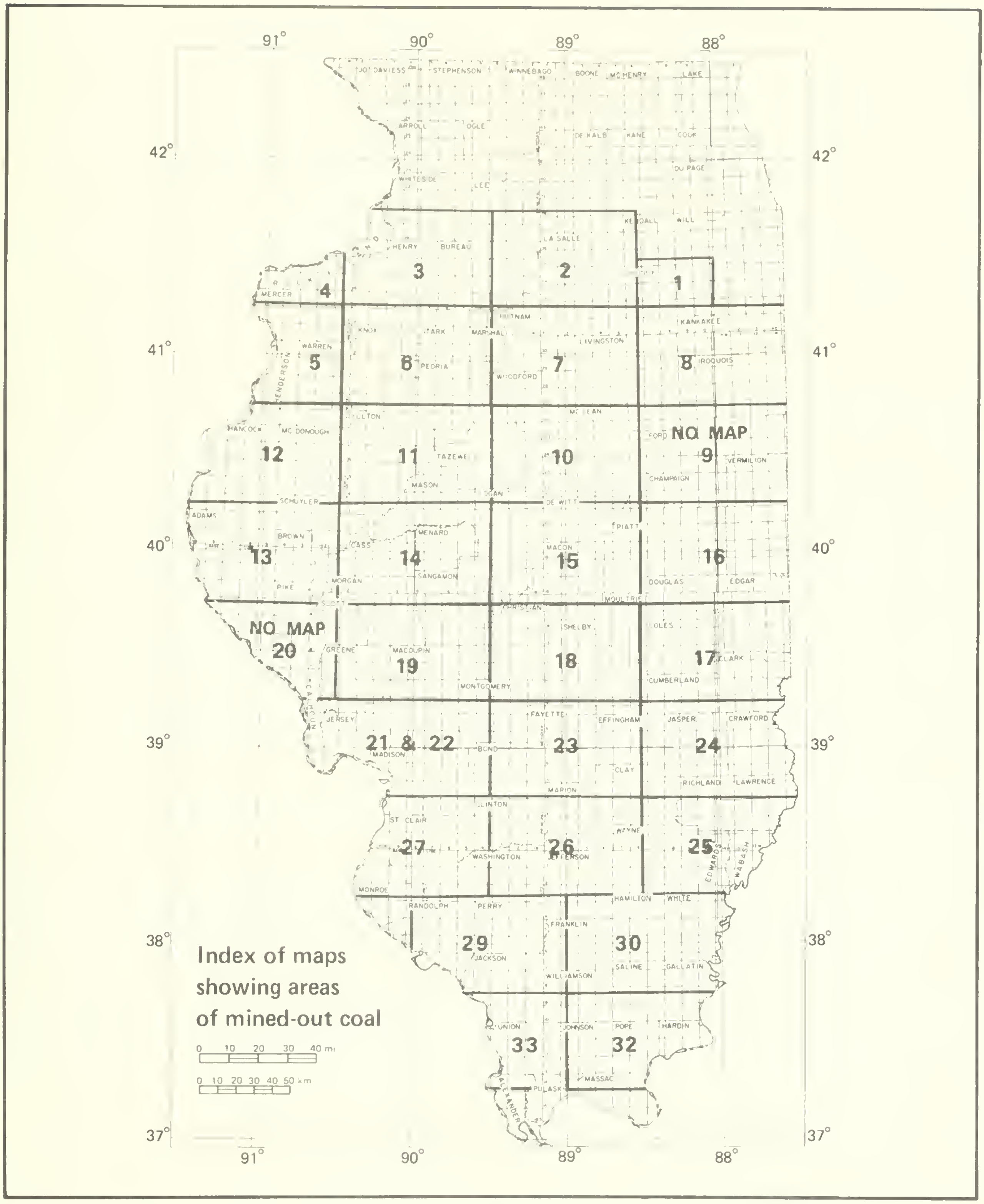


Figure 15. Maps of areas of mined-out coal. Blue-line prints dated January 1, 1976 (revised from time to time), show outer boundaries of workings of active and abandoned coal mines and miscellaneous mine data; towns, railroads, quadrangle boundaries; and section, township, and county lines. Scale, 1 inch = 1 mile. *Areas 9 and 20 are not mapped.* (From ISGS, *List of Publications,* 1980.)

Large maps are $1.50 each; small maps (areas 1 and 4) are $1.00 each, plus 5 percent state retailers' occupation tax. PLEASE ORDER BY NUMBER. Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820.

Street, Springfield, IL 62706). At your request, the team will investigate your house. If subsidence is in progress, they may suggest you do some of the things mentioned earlier. They may also arrange for immediate work to prevent additional damage. The U.S. Office of Surface Mining makes funds available if life and/or property are in danger. Although these funds cannot be used to repair houses, they can be used to prevent additional damage, thus providing a sizeable savings to the homeowner.

If your insurance agent or the Subsidence Rapid Response Team find your home is not subsiding because of a mine, they may be able to suggest what is causing the problem and whom to contact.

SELECTED BIBLIOGRAPHY

Andros, S. O., 1914a, Coal mining practice in District I (longwall): Illinois State Geological Survey Mining Investigation Bulletin 5, 42 p.

Andros, S. O., 1914b, Coal mining practice in District VI (mines in bed 6 in Franklin, Jackson, Perry, and Williamson counties): Illinois State Geological Survey Mining Investigation Bulletin 8, 49 p.

Hunt, S. R., 1980, Surface subsidence due to coal mining in Illinois: University of Illinois, Urbana, Ph.D. dissertation, 129 p.

Killey, M. M., 1975, Ancient dust storms in Illinois: Illinois State Geological Survey Geogram 5, 2 p.

Illinois State Geological Survey, 1980, Maps of areas of mined-out coal: List of Publications, p. 95.

Illinois State Geological Survey, 1980, Review of underground mining practices in Illinois as related to aspects of mine subsidence with recommendations for legislation: Illinois Institute of Natural Resources Document No. 80/10, 142 p.

Wildanger, E. G., J. Mahar, and A. Nieto, 1980, Sinkhole type subsidence over abandoned coal mines in St. David, Illinois: Abandoned Mined Lands Reclamation Council, Springfield, IL 62706, 88 p.