

# Petrographic and thermal image analysis of volcanic stones used for massage

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## SUMMARY

**Background.** Hot volcanic stone massage (HVSM) has already become such a popular procedure that it is included in the offer of most of the big centers for disease prevention and treatment, centers for psychosomatic recovery or beauty centres. At the same time, however, there are not reliable scientific papers describing this approach. The goal of this study was petrographic and thermal image analysis of selected stones available in Polish market, used for massage.

**Material and methods.** Selected igneous stones used for massage procedures were studied. The petrographic analysis was conducted using a thin film phase plate microscopy in light beams passing through. Mineral composition of the rock material was assessed as well as the structure and texture of rock. The thermal image analysis of the rock material was carried out using Thermo Vision A20M camera cooperating with a personal computer equipped with Therma CAM Researcher 2.8 program.

**Results.** The obtained results illustrate typical petrographic features of stones used for massage, temperature distribution on the surface of hot stones, and changes in temperature during stone cooling.

**Conclusions.** Petrographic and thermal image studies of selected stones used for massage suggest that the usefulness of such stones in therapy is determined both by thermal and specific petrographic features of rocks, such as their fine grain or microcrystalline, massive and uniform texture.

KEY WORDS: hot volcanic stone massage, thermal imaging, petrographic analysis

## Background

The need to conduct experimental studies of massage procedures using hot volcanic stones is urgent as nowadays people belonging to the occupational group of physiotherapists or cosmetologists are increasingly often employed in centers for psychosomatic recovery. These therapists, carrying out massage procedures using stones on a daily basis, do not only expect that the scientific milieu will be more interested in this approach, but also need more substantive support, justifying the application of this approach, based on the results of the empirical studies on using stones both in prevention and treatment.

The available sources report that hot volcanic stone massage (HVSM) is a form of treatment that has been popular for millennia. It was a part of Far East philosophy and also was used in India as early as 5000 years ago. The Chinese believed in the favorable effect of volcanic stones which were extracted from water bodies where they were for years subjected to natural processing and polishing. Indians are regarded fathers of this procedure as they used stones collected from river canyons for it. The paper also reports using stones originating from Peru, Hawaii and Bali Island. Hot volcanic stone massage (HVSM) is a combination of thermotherapy, acupressure, drainage and working with energy. The massage decreases muscle tension and accelerates excretion of harmful metabolic products. Acting on the muscle tissue, it regenerates it after a long-lasting effort and increases muscle ability to perform next work. It seems, however, that the greatest popularity of HVSM treatment is nowadays mainly connected with its powerful effect on the nervous system.

The massage effectively relieves the consequences of excessive stress and has a generally relaxing and toning effect on many body systems. The effectiveness of HVSM massage is also connected with their favorable effect on the skin, resulting in elasticity improvement. HVSM helps reduction of cellulite tissue and accelerates blood and lymph circulation in dermal blood vessels. The procedure also favorably affects the circulatory and lymphatic systems through facilitation of venous blood outflow and reduction of blood resistance in arteries. HVSM procedure is especially recommended to persons with increased muscle tension as well as fatigued, distressed persons and these suffering from rheumatoid conditions of joints. The indications for this procedure also include overload states, metabolic problems including obesity and conditions after paralysis and paresis. It can also be applied in such conditions and health-related problems as: multiple sclerosis, fibromyalgia, states of psychophysical fatigue, musculofascial pain, functional disorders of internal organs of non-inflammatory origin, slight arterial hypertension, stress syndromes of the musculoskeletal system and decrease in life force. The contraindications for relaxation massage using hot stones include, apart from those described for classic massage, especially such conditions as pregnancy, circulatory insufficiency, sensibility disorders, depression states, mental disorders, neoplastic diseases and fever [1].

The methodology of HVSM may be highly differentiated, depending mainly on the purpose of the procedure and patient's health state. Most often the main massage procedure is preceded by performing a short, 10-20 minute classic massage. This initial massage is very im-

portant as it allows the therapist to learn about the areas and degree of body cooling and assess the tone and reactivity of tissue structures, vascular responses and patient's sensitivity to tactile stimuli. Next, depending on the determined methodology of massage procedure, the therapist puts stones on the massaged area. The stones are placed directly on the patient's body or on the towel covering the massaged area. In the first case, the temperature of stones used for the procedure should be similar to body temperature and adapted to the patient's individual sensitivity. In the second case, a therapist can use hotter stones, but only when there are no contraindications for intense body heating. In elderly individuals and children, the therapist should resign from putting stones on the body or he should exercise a special caution doing so. Stones, when cooling, transfer heat to the ambient air and overheat the massaged tissues. After initial body overheating, the real massage is performed using stones. The therapist, massaging the patient's body with a stone held in his hand, has to adjust stone temperature and the speed of movement performance as well as the surface size (massage with stone edge or the entire surface of the stone) of the stone and the pressure exerted with the stone to the patient's thermal and mechanical sensitivity.

Presently, stones for massage are available on the Polish market. These are mainly basalts and their abyssal equivalents, such as gabbro with a standardized size and shape. Magma, the material the above mentioned stones are built of, can be formed deep in the Earth's mantle or in shallower layers, namely in the crust of the Earth (Maneck and Muszyński, 2008). Plutonic rocks are formed as a result of magma congealing in the form of intrusion very deep below the Earth surface (e.g. several or over a dozen km) and volcanic rocks solidify on the surface as lava streams or very shallow under the Earth surface in the form of fine intrusions. The color of rocks – stones – depend mainly on such factors as general chemical composition, the type and proportions of rock-forming minerals and the size of mineral grains. Magma rocks originating from the deep zones of the earthy mantle are low in silica ( $\text{SiO}_2$ ) and rich in calcium, magnesium and iron; the rocks formed from them consist of such minerals as olivines (magnesium iron silicates), pyroxenes (calcium, magnesium and iron silicates) and plagioclases (sodium-calcium feldspars, sodium and calcium aluminosilicates). These rocks are generally dark and can be fanerocrystalline, coarse grained (e.g. gabbro is usually a grey abyssal rock) or cryptocrystalline (e.g. basalt is a black volcanic rock; diabase has similar properties). Igneous (magma) rocks, found on shallower levels of the lithosphere are richer in silica, sodium and potassium. From these igneous rocks such minerals as sodium and calcium feldspars (potassium aluminosilicates), plagioclases (sodium-calcium feldspars – sodium and calcium aluminosilicates), quartz ( $\text{SiO}_2$ ) or biotite (hydrated potassium, iron and magnesium aluminosilicate) are crystal-

lized. The rocks composed of these minerals are usually light-colored and can be fanerocrystalline (e.g. granite is a light grey or reddish-grey plutonic rock). They can be also fine grained and cryptocrystalline (e.g. porphyries are volcanic and subvolcanic rocks, pink or red in color) [2].

The rocks used for massage, after appropriate shaping are ground and polished, some of them are also milled (Figure 1). Naturally shaped stones are more seldom available for sale. Some of them are not subjected to any treatment procedures, apart from semi-polishing or polishing (Figure 2).

The goal of the study was petrographic analysis and thermal imaging analysis of selected stones used for massage.

## Material and methods

The kinds of stones which are most often used by masseurs for massaging procedures. Petrographic analysis was conducted using a thin film phase plate microscopy in light beams passing through. The mineral composition of rock materials was assessed as well as rock structure and texture. Thermal imaging analysis was conducted using Thermo Vision A20M camera, cooperating with a personal computer equipped with Thermo CAM Researcher 2.8 program.



Figure 1. A ground stone of a standardized size



Figure 2. A polished stone having a natural shape

## Results

### *Petrographic analysis*

Figures 4-1 and 4-2 present microphotographs of basalt stone used for massage. The presented rock can be defined as basalt or diabase. The rocks differ in geological forms (basalts form lava while diabases form fine intrusions), but in microscope preparations they show the same mineral composition and similar textural features and their definite recognition is problematic. In this paper, the term basalt is preferred as a more general term. The main mineral components of the presented rock include plagioclases and clinopyroxenes (diopside?) and, in smaller amounts, Fe-Ti oxides (ilmenite and/or magnetite). The secondary components, present in small amounts include olivins, volcanic glass and minerals from carbonates group. Olivins locally accompany pyroxenes while the glass and carbonates are clustered in corners between plagioclases and pyroxenes. The above mentioned secondary components are poorly visualised in the presented photographs. We can see, however, a typical basalt texture: microcrystalline (crystals of dimen-

sions of tens of mm and smaller), subautomorphic (overgrowing crystals of different shapes), heterogranular (crystals of varied diameters), massive (no gaps between crystals) and disorderly (chaotic arrangement of components). In the scale thin film phase plate and the entire stone the rock is highly uniform and does not show variability of mineral composition and texture. The above mentioned petrographic characteristics of rock apart from their thermal properties, can be indicative of special usefulness of basalts in massage procedures.

### *Thermal imaging analysis*

Figures 5 and 6 present heat distribution in each layer of the stone used for massage, depending on the texture of the rock material heated in water in the heater to about 100°C.

## Discussion

As it is initially mentioned, despite, despite a thousand year history of using stones for treatment and many practical references related to the application of stones in massage procedures, the method has not been well de-

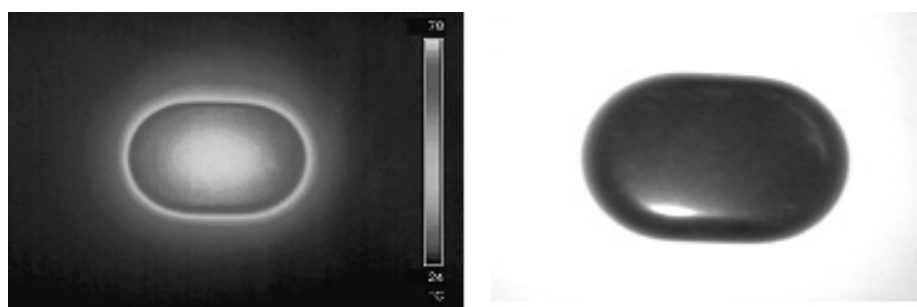
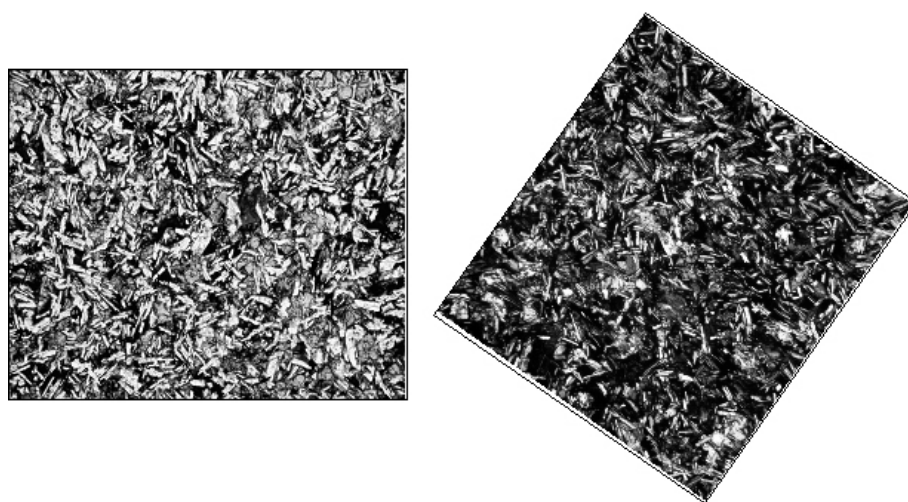


Figure 3. The stone used for the petrographic analysis (on the right - stone image, on the left - the same stone heated in a heater in thermal imaging camera image)



Figures 4-1 and 4-2. Micro-images of the thin film plate of the rock used for massage. The photograph on the left – without an analyzer, photograph on the right – the same field with crossed polarizers. The length of the shorter side of the photographs is about 4.4 mm. The presented rock is basalt and the main mineral components are plagioclase (Pl), clinopyroxene (Cpx) and opaque minerals (ilmenite and/or magnetite, Opq); in photograph 1-1: Pl – colorless, Cpx – light brown, Opq – black; in photograph 1-2: Pl – white/grey, Cpx – colorful, Opq – black). The rocks are described in detail in the text

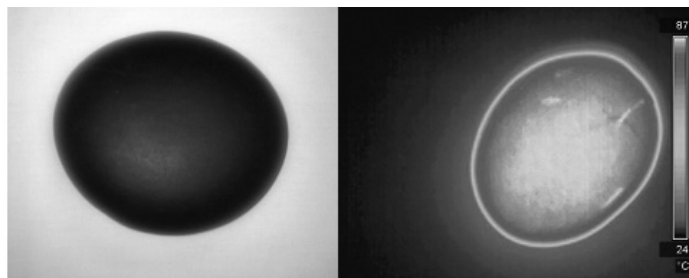


Figure 5. A non-ground stone of a natural shape and fine grained texture (on the left). On the right – the same stone heated in hot water in the thermal image

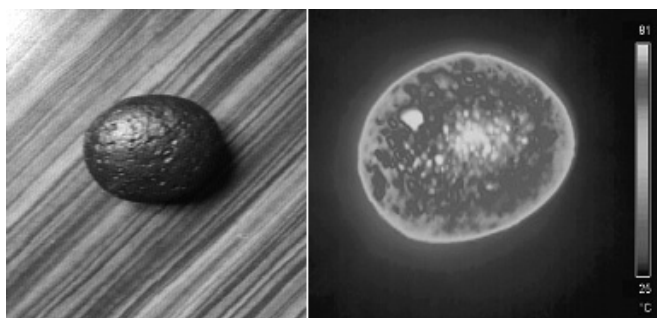
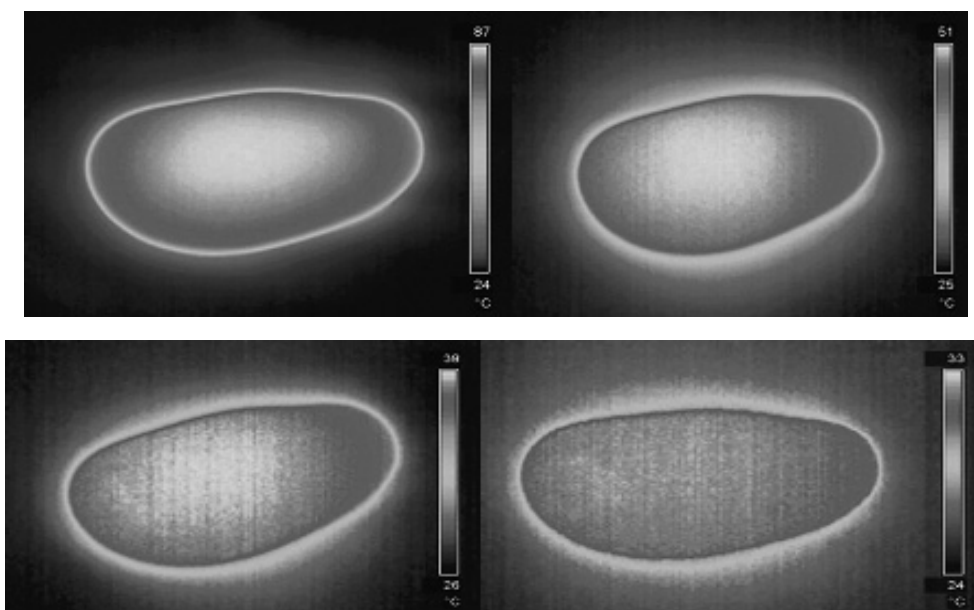


Figure 6. A non-ground stone of a natural shape and coarse grain structure (on the left). On the right – the same stone (heated in hot water) in the thermal image



Figures 7-10. Cooling of a stone used for massage in thermal image. Photographs were taken in 15-minute intervals

scribed yet in scientific literature. The latest study on this issue (the year 2013 ) pertains to the analysis of temperature distribution in the bodies of 25 healthy young females, treated using warm basalt stones placed on their bodies. The stones were put on various areas of the body on the towel covering the patient’s body. Earlier, the stones were heated in water to the temperature of 61-63°C by over 30 minutes. The authors of this report emphasize that such studies are necessary for future safe application of thermotherapy using stones in clinical health problems [3].

Witoś et al. recorded body temperature distribution using thermal imaging (Thermo Vision A20 M) in the sample of 15 females after three massage procedures using volcanic stones in the dorsal part of the trunk. The values of minimal, maximal and average temperature were analyzed prior to and after each procedure in each subject. A gradual increase in temperature was found in the massaged tissues during consecutive procedures. In 33% of the subjects, the difference between mean temperatures before and after the procedure did not exceed 2°C. The difference in mean temperatures between procedures in 20% of the studied females was 3°C or more than 3°C. In

the remaining group of study subjects the mean value of temperature differences ranged from 2 to 3°C. The detailed analysis of thermograms showed that the differences in temperatures before and after the procedure were individual. The HVSM procedure also had a favorable effect on patients' bodies by pain reduction as well as on their mental state [4].

Bartelmus [5] described the application of stones in healthy newborns and infants. Magiera described the conception and effect of stone massage [6]. Walaszek in "Refleksoterapia" (Reflexotherapy) journal described the fundamentals of stone application in prevention and treatment, the history of stone massage, the accessories necessary to carry out stone massage, indications and contraindications for such procedures [7,8].

Recently, thermal imaging technique is expected to bring progress in studies using hot volcanic stones, allowing noninvasive and precise assessment of changes in surface temperature after various thermal procedures. This concerns cryotherapy and cryostimulation studies as well as using various massaging techniques [9].

Petrographic analyses of the rock material are also important as the stones are used for massage procedures due to their subtle effect on patient's body, depending on their physical properties. From the point of view of geology and petrology, the stones applied in massage procedures belong to crystalline rocks group. Mainly due to their high heating capacity and their petrographic constitution, usually igneous rocks and more seldom, metamorphic rocks are used for HVSM. The stones are most often obtained from open-pit mining, or from the rock material washed by rivers. Igneous material includes both abyssal (plutonic) rocks and volcanic rocks. A wider application of the latter is reflected by the name of the discussed treatment approach. The texture of basalt rocks used in HVSM is also important – it is a cryptocrystalline, massive and uniform structure. Thanks to this structure, the stone after polishing is smooth and feels nice in the contact with the patient's body.

## Conclusions

Petrographic and thermal imaging studies of selected stones applied in massage procedures suggest that the usefulness of these stones in treatment depends on their thermal capacity and certain petrographic properties of rocks.

There is an urgent need of undertaking further experimental studies on the properties and potential of volcanic stone application in massage due to the fact that the people from occupational group of physiotherapists and cosmetologists are increasingly often employed in centers of psychosomatic recovery where such procedures are standard.

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