

FROM MEGALITHIC CIVILIZATIONS TO MARTIAN ROCKS: BUILDING A FUTURE BASED ON ECOLOGICAL WISDOM IN PAPUAN TRADITIONAL TOOLS

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Abstract—The megalithic tradition is increasingly lost, eroded by changes in human life patterns, and has a considerable influence on the progress of modern civilization. Megalithic cultural heritage can still be maintained by adopting human values, attitudes, and actions as a way of life to build a new civilization. This study aims to determine the form of megalithic cultural heritage that the people of Papua are still maintaining in sustainable development based on ecological wisdom for human exploration missions on Mars. This study uses a descriptive analysis method with a qualitative approach to find and explain stone materials as the foundation for building human civilization and looking for the potential for extra-terrestrial life in the discourse on the colonization of Mars. The results of this study indicate that megalithic cultural heritage in Papuan human civilization can still be found in tools of living based on ecological wisdom, such as stone axes and traditional stone-burning ceremonies. Papuan people and stone civilization are the embodiment of a unity that cannot be separated in the life of modern society. The legacy of megalithic culture becomes cultural capital (knowledge and intellectual skills) and social capital (gotong royong, trust, cooperation, and empathy) rooted in internalizing values that live and develop in society. Intangible cultural heritage that lives from the past can be adapted for future patterns of human life combined with the development of science and technology. Processed products from basalt or andesite rocks found on the surface of the planet Mars can be used as raw materials for the manufacture of tools for the life of Papuan people in the future by taking care of cultural practices characterized by megalithic traditions.

Keywords: megalithic, martian rocks, ecological wisdom, Papuan, traditional tools

INTRODUCTION

Papua is an island located in the north of Australia and part of the eastern region of Indonesia. Papua is the second largest island in the world after Greenland and Canada, with residents belonging to the Melanesian family who have physical characteristics such as black skin, curly and wavy hair, and a stocky and tall body. Papua is known as the Earth of Cenderawasih or the Earth of the Rising Sun. It is divided into six provinces: Papua, West Papua, Central Papua, South Papua, Mountain Papua, and Southwest Papua. Indigenous ethnic groups in Papua consist of 255 tribes with regional languages, each with 268 different languages. Indicators for the division of

tribes in Tanah Papua based on territorial boundaries and similarities in aspects (kinship relations, marriage, customary rights, type of leadership, physical characteristics, geography, and others) into seven customary territories, namely Mamta, Saereri, Anim Ha, La Pago, Mee Pago, Domberai, and Bomberai. The ethnic groups referred to as indigenous Papuans have different socio-cultural characteristics from one another because they are influenced by natural conditions (ecological zones) in the Land of Papua. Papua's natural conditions are divided into four ecological zones, namely: (1) the swamp zone, beach and along rivers (Asmat, Jagai, Marind-anim, Mimika, and Waropen areas); (2) the highland zone (Dani, Ngalun, and Ekari or Mee people); (3) the foothills zone and small valleys (areas of Sentani, Nimboran, Ayamaru, and Muyu people); and (4) lowland and coastal zones (Sorong to Nabire, Biak and Yapen) [1]. These natural conditions affect all cultural elements of ethnic groups or ethnic groups that occupy the four ecological areas: equipment or technology systems, traditional, religious systems, social organizations, knowledge systems, and art (traditional architecture, music, dance, sculpture, and painting).

Traditional living equipment is one of the ancestors' cultural heritage, which needs to be maintained and preserved. These traditional tools still survive some people, especially in rural areas. Traditional equipment is generally seen as something that is considered old-fashioned and not under the times. Clyde Kluckhohn, in *the Universal Categories of Culture* (1953), states that tools and equipment for human life (clothing, housing, household appliances, weapons, means of production, etc.) include seven cultural elements. Art in Papua is a rite inseparable from people's lives in every traditional activity held in the Papuan life cycle ceremony (life cycle), hunting animals or fishing, fighting, ceremonies for opening new land, and so on. The life of the Papuan people has traditionally been inseparable from art as a medium of communication with others and to supernatural forces that always give hope to them [2]. Equipment for traditional ceremonies aimed at performing rituals is a form of expression of local genius with artistic value and socio-cultural products in the spiritual dimension passed down from ancestors and ancestors. The living equipment and technology system are

part of the cultural elements used to meet the needs of traditional community life related to knowledge systems that are abstract and tangible in human ideas. In the Papua region, there are still traditional people who live in a primitive way by adhering to traditions that have been passed down from generation to generation, viewing the universe, making sure objects are sacred, believing in things that are occult and magical, and have a variety of religious ceremonies and beliefs. The culture was born to establish a relationship between the living and the living dead [3].

The Austronesians influenced megalithic culture in Papua in the Neolithic period in the area between Madagascar in the west to Easter Island in the Pacific in the east and Formosa in the north. The results of archaeological research in the Papua region show that megalithic traditions not only exist in coastal areas but also reach inland areas and the central mountains of Papua [4]. The form of heritage from the megalithic culture in the Papua region does not only lead to a large stone building but also to the concept of belief to be used as ceremonial equipment. This is also explained by Frits A. Wagner in *Indonesia: The Art of an Island Group* (1959), which states that small stones can be categorized in the megalithic sense if the object is made for the sacred purpose of worshipping the ancestors. Megalithic objects manifest the idea of belief in ancestor worship, which led to the development of deep human thinking, as well as adaptations made by humans to the natural environment in producing innovations to support their survival. The megalithic tradition does not refer to a particular era of civilization. However, it is instead a form of expression of a traditional society that has developed due to the belief in magical or non-physical powers supported by the availability of natural resources around it. The term megalithic tradition is more appropriate for a society that continues the customs or habits carried out by their ancestors [5]. Therefore, the tradition in question is a cultural phenomenon that continues for sufficient time to be interpreted as a custom or habit passed down from generation to generation within a community group.

The existence of megalithic culture in the Neolithic period after the tradition of farming to meet food needs by developing agricultural tools made of stone, such as stone axes. The object is oval with a pointed tip at the base and widens at the sharp end, which is commonly found in the Papua region. Sharp parts are made by sharpening in two directions to produce a sharp and symmetrical shape. The stone used is complicated and beautiful, blackish green in color, and obtained from mountainous areas (river stone). The oval axe found in Papua is called the Neolithic Papuan Ax [6]. Megalithic culture not only produced objects made of stone as tools for human life for hunting and gathering food but also the technology of cooking food by burning, which humans did after the discovery of fire in the Mesolithic period. Stone burning is a cultural tradition of the ancestors of the Papuan people that still survives as an expression of gratitude to God and a potent symbol of solidarity. The stone burning ceremony or *barapen* is a

tradition passed down from generation to generation by the Dani tribe in the Baliem Valley in the mountains of Papua. As a sacred local cultural ritual, the stone burn represents local people in the central highlands of Papua [7]. The traditional living equipment used by indigenous peoples is inseparable from the technological system in the process and the purpose of making it. However, it is also influenced by local wisdom toward preserving the natural environment. The technique used in making traditional Papuan tools is intangible, becoming an intangible cultural heritage that can be lost along with the times and technological advances.

Space research can bring knowledge, discoveries, and improvements regarding the pattern of life that humans do on Earth. The quality of human life on planet Earth is inseparable from the quality of their living environment to meet the needs of life and socio-economic life, which the availability of adequate natural resources must support. Gerard K. O'Neill, in *The Colonization of Space* (1974), mentions that intergalactic colonization can save the future of humanity by migrating from planet Earth to other planets. The search for planets that may have life outside the solar system is a popular topic to find planets that have the potential to be habitable by humans in the future. The habitable zone is considered the following criterion for planets that qualify as Earth's counterparts, such as planetary conditions that must be rocky with atmospheric pressure that can maintain water in liquid form [8, 9]. In the future, two things will become rare and difficult for humans to find: nature and culture. Humans are bio-socio-cultural creatures, which means that humans have the ability, like organisms, to adjust to new environmental conditions. Humans, culture, and the environment are three integrally interrelated factors [10]. Traditional societies have continuously developed and adapted intangible cultural heritage, including knowledge and practices regarding the environment and social practices, to address primary and social needs issues across space and time. Environmentally sustainable development in the context of tradition is the central dimension or pillar for discovering the pattern of human life in the future by optimizing the exploration of outer space resources.

Research has been conducted on megalithic traditions in the Papua region by Erlin Novita Idje Djami in *Ragam Bentuk Tinggalan Budaya Megalitik Di Papua* (2016). This study explains the background of megalithic traditions in the Papua region influenced by the Austronesian people, which are closely related to religious activities and socio-cultural activities that have been found since prehistoric times. Tara Steimer in *Indonesian Megaliths: A Forgotten Cultural Heritage* (2018) explains the end of megalithic culture in Indonesia because it was influenced by the collapse of the Hindu-Buddhist kingdom and belief as a primitive religion that was not recognized administratively and constitutionally based on Pancasila as the basis of the state. Riri Maryone researched megalithic cultural heritage that still survives in the Papua region in *Fungsi Kapak Batu Papua dalam Mempersatukan Keragaman* (2017), which explains the use of stone axes as

a work tool in traditional ceremonies and a very high social function as a means of paying fines, or prizes, and can play a role in strengthening national and state identity which is passed on to the younger generation through local content education. Bakar Batu as a local cultural rite has attracted many researchers to study this traditional ceremony, such as Abet Nego Tabuni in *The Cultural Values and Functions of Bakar Batu in Nilai dan Fungsi Budaya Bakar Batu Dalam Relasi Lintas Suku di Pegunungan Tengah Papua: Sebuah Kajian Sosiologi Budaya* (2023). The study results concluded that raw fuel has a complex value content to become a cultural representation of the local and immigrant communities formed from a process of learning together. Sri Nurani Kartikasari, Andrew J. Marshall, and Bruce M. Beehler wrote a study on Papuan ecology in 2012. The book explains biogeographical data, historical references, and insights regarding the conservation of Papua's natural environment, which has biodiversity and culture in the long term. Based on the above, this paper will discuss the megalithic culture still maintained by the people of Papua in sustainable development based on ecological wisdom for human exploration missions on Mars.

RESEARCH METHOD

This study uses a descriptive analysis method with a qualitative approach. Descriptive research examines the status of human groups, objects, conditions, systems of thought, or current events to make systematic, factual, and accurate explanations regarding the facts studied [11]. Qualitative descriptive research is intended to describe phenomena that occur naturally and humanly by paying attention to characteristics, quality, and interrelationships between activities. This research method can bring researchers closer to the object under study so that researchers directly observe; in other words, researchers act as the primary research tool. This study aims to find forms of reproduction of megalithic culture in the pattern of life of traditional Papuan people in the future in the discourse design of the colonization of Mars. The research was conducted for three months, from June to August 2023. Qualitative research emphasizes meaning and focuses more on quality data with qualitative analysis to produce an understanding of the correct conclusions from data sources in the form of events or activities, places or locations, objects, images, recordings, and documents. Data collection techniques used are observation, documentation, and literature study. In this study, researchers made non-participant observations because they acted as passive participants in the data collection. They are collecting data with a literature study to study various literature related to the problem to be studied. The data analysis consists of three activities that coincide: data collection, data reduction, data presentation, and conclusion and verification [12]. The results of the data analysis from this study are in the form of a description of the situation of the object under study in the form of a narrative description.

RESULTS AND DISCUSSION

Megalithic Tradition As A Stone Of Modern Civilization Of The Papuan Ethnicity

Megalithic comes from the words *mega* (large) and *lithos* (stone), interpreted broadly as archaeological remains in large stones made and used by humans for specific purposes. According to adjectives, megaliths emphasize things related to or marked by the existence of prehistoric buildings made of large stones [13]. In the science of morphology, megaliths are interpreted as rocks arranged or worked on and used by humans as a profane culture. Megalithic tradition in archaeology is divided into two waves: the old and younger megalithic traditions. The old megalithic tradition produced dolmens, menhirs, stone thrones, and so on around 2500-1500 BC, while the younger megalithic tradition developed during the Perundagian period (Early AD) produced sarcophagi, stone tombs, statues of ancestors, and so on [14, 15]. The remains of megalithic culture have a wide distribution on earth from the continents of Africa, Asia, America, Europe, and Australia [16, 17, 18]. Forms of human work in prehistoric times in the form of megalithic cultural heritage can be found in various regions in Indonesia, from the tip of Sumatra to Papua. The theory regarding the entry of megalithic culture into the Papua region is said to have originated from Asia which went through two routes, namely first, the Indonesian archipelago to the south and ended in Maluku, but its influence reached Papua in the north to the Mamberamo river. In contrast, in the south, it reached the coastal areas south of Papua (Kaimana and its environs) across the Kei and Aru islands. Second, megalithic influences in Papua originate from an area located between the islands of Taiwan (Formosa), the Philippines, and North Sulawesi, which spread to Micronesia and spread to New Guinea through the Admiralty islands, which are located north of Papua New Guinea. In Papua New Guinea, this culture enters through the Monumbo area, which is located on the north coast of Papua New Guinea and along the estuary of the Sepik River, the Oinake coast, the Tami River, Sae (Skow-Mambo), Humboldt Bay (Yos Sudarso), Nafri and Lake Sentani.

Megalithic culture in Papua can be found in coastal areas to the central mountains in the form of relics of terraced buildings, *mareuw*, stone pillars, *ainining duka*, stone mortars, whetstones, stone rows, spirit paths, *temugelang* stones, megalithic areas, memorial stones, stone thrones, *menhir*, dolmens, etched stones, rock carvings, *totor*, and slate stones. The findings from the cultural heritage of the megalithic tradition are closely related to religious, social, cultural activities, and so on [19]. Traces of ancient human historical and cultural heritage in Papua during the Neolithic period that are better known by the public are the Tutari megalithic sites. The findings of etched stones on large boulders can be categorized as rock art, namely an art form that is poured on the rock that can be poured in the form of scratches on the boulder as a medium. Coralie Girard in *Prospection D'un Site D'art Rupestre Longtemps Oublie En Nouvelle-*

Guinee Site de Tutari (2017) explains that the stones used to etch the motifs for paintings depicting humans, fish, and animals come from the Cyclops Mountains, which are classified as igneous rocks Peridotite, while black stone blocks used as a painting medium are called Gabbro Stones. The archaeological findings from the megalithic period, mostly made of stone, indicate the environmental conditions and technology used to exploit the available and organized resources. Being organized means the regularity of human life, which no longer carries out hunting and food gathering activities, but also the habit of nomadic life being replaced by raising livestock and farming using living tools made of stone, wood, and animal bones. The values contained in culture become a reference for human attitudes and behavior as individual creatures that cannot be separated from their relationship with people's lives with a distinctive cultural orientation [20].

Tracing megalithic traces in the civilization of the Papuan people, one can find a civilizational stone or inspirational stone located on Aitumieri Hill, Teluk Wondama Regency, West Papua Province. Archaeological evidence known as Sasaar Wondama means Wondama Light became Isyak Samuel Kijne's seat in contemplation in search of ideas or inspiration about the progress and civilization of the people of Papua in the future. Pastor Izhak Samuel Kijne, a German national called the father of Papuan civilization, founded a *zending* school for natives whose aim was to carry out evangelism or spread Protestant Christianity. On this historical site, Izhak Samuel Kijne wrote a message on the civilization stone in Wasior on October 25, 1925: "On this stone, I place the civilization of the Papuan people. Even though people have high intelligence, reason, and knowledge, they cannot lead this nation. This nation will rise and lead itself". Peradapan stones in the form of piles of stones are a means for *zending* (propagator of Christianity) to carry out the learning process believed by the community as witnesses to the early history of modern civilization of the Papuan people. The Wondama Bay area also has megalithic cultural heritage objects associated with animist beliefs in stone materials that have magical powers in the legends of the Papuan people, such as the Mawe Stone in Menarbu Village, east of Roon Island, which is said to be a stone that can grant wishes. Local people give the name *kanggoandi*, which means a place to rest [21]. The prehistoric site is a stone mortar made of andesite stone measuring 37 cm long, 24 cm wide, and 9 cm thick [22]. According to a myth the local community believes, someone who succeeds in lifting the stone with both hands will feel light if their wish is granted. However, conversely, if the Mawe Stone is lifted, it is complicated and heavy to the point of dropping it, and that person's wish will not be granted.



Fig 1. Sedimentation Stone in Wondama Bay
 Source: medcom.id

Humans and civilization are the embodiment of a unity that cannot be separated in a perfect sense. Civilization comes from the word *adab*, which means morals or decency and the delicacy of human behavior. Good manners are the noble values embodied in the outlook on life of the Papuan people in building national character in the modern era through a culture of local wisdom. This local wisdom becomes social capital in the form of religion, culture, and customs to connect the Papuan people with the past and the future, from generations of ancestors to present generations. Social capital is a product of human relations, which refers to norms, beliefs, and networks [23]. Papua experienced a leap of civilization by abandoning Stone Age technology, which was influenced by missionary visits during the *zending* period (Ottow and Geissler) as a sign of modernization. The preaching of the Bible in the Land of Papua forced the Papuan people to become familiar with *listing* (*baca, tulis, hitung*). Modernization transforms traditional or pre-modern life regarding technology and social organization toward economic and political patterns [24]. Modern society has a cultural value orientation directed toward life in today's civilization, so it can be interpreted as a form of transformation from traditional society to modern society that is more advanced in technology, science, and ways of thinking. Modernity has changed the pattern of life of the Papuan people, which is influenced by the status and power hierarchy with the open flow of mobility of the Papuan people to various regions in Indonesia to look for work and go to school or college, as well as the introduction of modern religions such as Christianity and Islam which offer an evolutionist view by demonstrating a different intellectual attitude critical of the Papuan mythology that developed in society.

Stone age stereotypes are still attached to the Papuan ethnicity, resulting from the formation of the construction of the mass media reality. The image of the Papuan people

is another subject with the term primitive as researched by Martin Slama & Jenny Munro in *From Stone-Age to Real-Time: Exploring Papuan Temporalities, Mobilities and Religiosities* (2015) states that the impression of the Papuan people is still living in the stone age packaged and distributed by the Dutch colonialists using new technology as a tool to show their power. Papuan people accept the primitive label as a sense of self that influences their behavior toward the outside world. Most of the tribes in Papua also live in a primitive way by adhering to customs passed down by their ancestors and inhabit the interior of Papua, which has not been touched by modernization and technology by using traditional ways or habits to live their lives. The traditional Papuan people have not entirely let go of their ancestral lifestyles, such as hunting, gathering, and shifting cultivation. So, the subsystems' social and cultural life patterns make it difficult to adopt the market economy model [25]. The Papuan people have cultural capital (knowledge and intellectual skills) rooted in the internalization of fraternal values in sustainable development influenced by customary kinship law to improve the quality of human life in the future. Indigenous Papuans who have lived in a particular territory since birth are bound by it and are subject to customary law with a high sense of solidarity. Every community member still adheres to customary rights (*beschikkingsrecht*), *patuanan*, or landlord rights. These, namely tenure rights, are in the hands of the village community based on customary law over a specific territory. Papuans have a historical awareness of Papuan identity, which was formed by adaptation to the environment in dynamic social relations with outsiders (immigrants).

Forms Of Ecological Wisdom In Megalithic Culture On Papuan Tradition Tools

Living equipment systems and technology result from knowledge, creativity, skills, and technology developed and maintained by traditional societies. Discussing traditional community living equipment is inseparable from manufacturing technology, the natural environment, and local wisdom. Humans use the system of living equipment and equipment for daily activities to fulfill the necessities of life. At the same time, the natural environment becomes the habitat of living creatures that provide raw materials for making equipment to carry out subsistence activities. Local wisdom is a view of life and knowledge, as well as various life strategies in the form of activities carried out by local communities in responding to various problems and meeting needs [26]. Local wisdom from traditional communities in Papua in managing their natural resources is articulated through religious media and local beliefs such as myths, rituals, and ancestors' messages that contain ecological knowledge. The living equipment used in Papuan culture adapts to the natural conditions (ecological zone) of the land of Papua. Humans interact with elements of the physical environment to form an ecological system called an ecosystem. Papua has biological resources in ecosystem types from estuaries,

swamps, lakes, savanna areas, lowlands, and highlands to alpine areas. Ecological studies are centered on humans and nature (environment) as an ecosystem that forms a life network to achieve a balanced relationship between humans and their environment. Indigenous peoples have a self-concept for managing the environment and lifestyle called traditional ecological knowledge [27]. Ecological wisdom is a way of thinking, acting, and behaving in utilizing and processing nature as a living environment and human life in a reciprocal manner [28]. The ecological wisdom contained in the megalithic cultural heritage in living tools that traditional Papuan people still use to build a cultural future and seek the potential to continue human life outside the earth.

1. Stone Axe

The stone axe is a relic of the megalithic culture, generally found in the Papua region in an oval shape with a sharp point at the base and widening at the sharp end. The sharp part is made by sharpening in two directions using other rock types to produce a sharp and symmetrical shape. The sharpening process will take six months to a year to produce a smooth and beautiful stone axe shape. The stone material needed for tool making has a reasonably high hardness value, so it has regular splits, will not break easily, and facilitates tool formation. The stone material must be able to produce shards to make sharps [29]. The oval axe is made of Nephrite type stone or blackish-green sedimentary rock formed due to the deposition of material from the erosion and weathering of water in rivers. Nephrite rock, known as jade, is a material produced from volcanic magma or metamorphic rock belonging to the Amphibole mineral group, often called the Tremolite mineral group, with the chemical formula $\text{Ca}(\text{Mg,Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$. Nephrit has a monoclinic crystal system with a Mohs hardness of 6.5-7 and a specific gravity of 2.95 gr/cm³. Nephrite is formed in metamorphic rocks under relatively low temperatures and high pressures. The oval axe found in Papua is called the Neolithic Papuan Ax, which uses wood and bamboo handles [30]. The function stone axes in several tribes in Papua are used for practical activities such as gardening and farming, as well as being of very high social function value as a means of paying fines or giving dowry gifts. Stone axes are used by residents in the Central Highlands region of Papua as a weapon to defend themselves from enemy attacks [31]. The value contained in the stone axe tradition is still maintained and preserved in the lives of the Papuan people who live in coastal and mountainous areas.



Fig 2. Neolithic Papua Axe
 Source: Inventarisasi Warisan Budaya Takbenda (Kapak Batu) (2012)

Stone axes in the Sentani cultural areas, namely *ayapo* and *bambar* (Doyo Baru) and Ormowari, are cultural products that function as work tools, such as cutting trees, beating sago, and making boats. These megalithic cultural relics also have a very high social function as a means of paying fines or giving valuable (gifts) to people who have helped. Types of stone axes (*he*) spread in Sentani culture based on color, including *the nokhong* (black), *he phinukhu* (black and green), *he hawaphu* (green), *he khongge* (black with white spots), *he hawa phulu* (greenish) *he raim rouw* (light green), *he yanggove* (dark green), *he hokhai* (reddish green), and *he rondo fikholle* (white green). The Dani tribe in Jayawijaya Regency and the Tolikara people still use stone axes in traditional ceremonies, such as the death ritual, to cut off a grieving woman's finger as an expression of grief over the loss of a family member. Stone axes are called *yara* (male axes) in the manufacturing process, attached to a rattan rope to a piece of wood, while *yao* (female axes) have a triangular shape with a larger size [32]. In the Marind-Anim tribe in Merauke Regency, stone axes are still used in traditional *dema* ceremonies as a form of respect for their ancestors. *Dema*, in the form of supernatural powers in the belief of the Marind-Anim tribe, is the spirit of the dead that can change shape into humans, animals, plants, or rocks. The oval axe or Papuan neolithic axe also provides much knowledge about migration, cross-culturalism, and multiculturalism so that a concept or idea can be maintained that can become an adhesive for the identity of a cultural community [33]. The stone axe in the culture of the Papuan people comes from the coastal, inland, and mountainous areas. It shows a close relationship between one another so that it contains values of solidarity and religious values that can provide a bond of life with the principles of togetherness and cooperation. Stone axes are objects of megalithic cultural heritage that reflect ecological wisdom in uniting the diversity of tribes in Papua. Making stone axes is done manually by utilizing the potential of mineral resources in the form of natural rocks used to meet human life's needs.

2. Stone Burn

Stone has a reasonably high history with human life as an object humans use to make fire. Early humans (*Homo Erectus*) made a fire in the Mesolithic era by rubbing two stones together to create sparks into flammable objects such as dry grass or leaves. The stone is a solid fuel that

can be burned to release energy and provide heat and light through combustion. The stone-burning ritual tradition means cooking by burning stones. The stone-fired method for preparing food can still be found in the culture of local people in the interior of the central mountains of Papua, known as the Dani or Ndani people or tribe. The stone-burning process is carried out first by making a small hole to insert the stone to be burned; after the stone becomes hot, the food ingredients to be cooked, such as pork, tubers, and leaves, are supplemented with vegetables. Epistemologically, stone burning comes from the local community's language, which has various names. In the Lani area, it is called *lago lakwi*. In contrast, in the Bintang Mountains, it is called *hupon*. In Wamena, stone burning is known as *kit abo isogo*, and the Nduga people call it *kerep kan* and are called *mogo gapil* in the Panyai community [34]. The ritual tradition of stone burning is practiced in various social events in Papua as an expression of gratitude to the giver of life in welcoming ceremonies for births, marriages, and deaths. Ritual is a means of communication with the divine or transcendent nature, so the stone-burning ritual that is carried out becomes a form of life history and beliefs held by traditional communities.



Fig 2. Stone Burning Tradition
 Source: tni.mil.id

In the past, the stone burning ceremony was a ritual party after carrying out the task of inter-tribal warfare or a symbol of peace upon reaching an agreement because peace had occurred between groups that were in dispute or involved in conflict. This traditional ceremony is a symbol of togetherness and the sacredness of social life because it is used in every significant event in the life of the Papuan people, such as resolving traditional wars, women's dowries, peace with the spirits of nature, and the celebration of the Christian faith, namely the celebration of Christmas and Easter [35]. The ritual of burning stones is a medium of worship to a divine figure who is believed to be able to provide assistance and protection in traditional community life. Primitive society has a more vital collective consciousness, namely understanding shared norms and beliefs. Eating on the ground on leaves conveys the close relationship between humans and the environment. From the perspective of local people, land has a philosophical value as mother or mama, meaning that land is the source of life for living things. Stone Burn philosophically emphasizes the importance of solidarity to share what one has in social life in building sympathy and

empathy for others and being a way of life instilled by ancestors to future generations. Traditional ceremonies are passed down from generation to generation and contain uniqueness, sacredness, and moral values. Clifford Geertz in *Local Knowledge: Further Essays in Interpretive Anthropologist* (1993) explains that traditional ceremonies become a system of symbols that integrate the ethos and conceptions of society concerning self-awareness of nature and everything that exists in the surrounding environment. Traditional cooking techniques with hot stones can also be found at the Arapus archaeological site on the island of Efate, located in the northern capital of Vanuatu. The cooking strategy using volcanic rock minerals from Melanesian cultural heritage is a process of local adaptation and diversification, influenced by ecological factors and the socio-political realm [36].

Reproduction of Papua's Megalithic Culture Against Mars Colonization Discourse

Mars was formed from a protoplanet orbiting the Sun. Mars has a life-processing magnetosphere layer that functions to ward off harmful radiation from the Sun (for example, alpha, beta particles, and solar wind) and Coronal Mass Ejection (CME). This planet has two natural satellites, namely Phobos and Deimos. This planet also has a rotation period of 24.62 hours and an orbital period of 687 days. Mars is known as the Red Planet due to large amounts of iron (III) oxide, which causes the planet's surface to be red and rusty. Ideas in science fiction have discovered the possibility of human colonization to continue life on Mars. The Mars Colonization Plan that was once carried out by SpaceX (a private space company) provides a direct indication of human life beyond Earth due to the influence of excessive exploitation of Earth's resources and the density of the human population on Earth, which has crept up to 9.8 billion by 2050 [37]. Humans face challenges in the future, such as in space colonization scenarios and the search for life on extraterrestrial planets. Humans tend to be dynamic, which means they are constantly moving from one place to another (migration). The nomadic lifestyle has been practiced by humans since the Old Stone Age (Paleolithic) during the Pleistocene, estimated to have lasted approximately 600,000 years. Human adaptability in adjusting to the environment is a biological need that must be met to ensure its survival. The cultural dimension is essential to the human-centered sustainable development paradigm [38]. Culture becomes a central pillar along with the environment, economy, and society in developing sustainable development discourse. This thought began to develop in 1995 through the World Commission on Culture and Development (World Commission on Culture and Development) publication concerning the centrality of culture in the relevance of sustainable development policies.

A tradition can change hands to be passed on to the next generation like a baton, which will be passed on to the next runner while maintaining its integrity. Tradition can

be translated as a habit carried out repeatedly and has become part of people's lives from generation to generation until now. Tradition produces a form of activity, belief, custom, and art attached to human beings while being maintained because it is understood as a principle that is not bound by time. Traditions originating from the past become a collection of material objects or human ideas that can survive for a certain period or be forgotten or even eliminated due to changes in the lifestyle of modern society [39, 40]. Culture does not mean that humans return to living like the past because it can be adapted for the present combined with the development of science and technology. Intangible cultural heritage can effectively contribute to sustainable development in realizing the potential of humankind's future life in outer space. Intangible cultural heritage as practices, representations, expressions, knowledge, and skills transmitted from generation to generation are continuously recreated by people or groups as perceptions and social interactions with the natural and historical environment. Intangible cultural heritage can help strengthen social cohesion in maintaining local community integration and foster a sense of shared identity and cultural continuity in the development of human civilization in the future [41]. The mobility of a person or group is an essential factor for the formation and change of human civilization by maintaining the original cultural identity and values in a different social environment. The affirmation of the cultural identity of immigrants in a new social life is called cultural reproduction. Reproduction results from repetition or imitation; the verb (reproduce) can be interpreted to reproduce or produce again.

Megalithic heritage is a cultural link that can influence the perceptions of living generations in defining and interpreting traditions carried out by local communities, as well as maintaining the existence of ancestral heritage that is given or continued in a straight line from the past, present, and future. Understanding Papuan culture cannot be separated from the philosophy of life of the Papuan people with a spiritual bond with nature. The indigenous peoples of Papua, in general in their cosmology, emphasize land as the center of human life. The land is a source of human livelihood because it contains economic, cultural, religious, and political functions. The increasing human population on Earth has given birth to ecological degradation that erodes human living space (land) and global warming caused by environmental deterioration processes that hurt sustainable development to maintain the quality of human life in the future. The issue of environmental damage and the population of the Earth's population exceeding capacity is an adaptive strategy to carry out the potential for human migration to Mars. The space colony base camp building project on Mars applies the principles of sustainable energy to meet current needs without compromising the ability of future generations. Sustainable energy has two main pillars: efficiency and renewables [42]. Research conducted on Mars meteorite rocks shows that most of the planet's surface is composed of basalt rock, so the planet's surface is composed of silica,

which has properties similar to andesitic rocks on Earth. Mars Pathfinder analyzed the soil surface on Mars with an Alpha Particle X-ray spectrometer (APXS) containing andesite [43, 44]. Basalt is a volcanic rock source rock that comes from the freezing of magma. Basalt rock has a dense and complex structure and has high compressive strength because it is solid and durable. Processed products from basalt or andesite rock can be used as raw materials to manufacture tools for the life of Papuan people in the future by maintaining cultural practices characterized by megalithic traditions.



Fig 3. NASA's Perseverance Rover on a Rocky Area in the Jezero Crater on Mars in February 2021
 Source: mars.nasa.gov

Mars rocks containing nickel are known as meteorites. SNC is classified into three groups: shergottites, nakhlites, and chassignites. NASA launched the Mars Pathfinder rover on December 4, 1996, to explore and identify Martian sedimentary rocks. The landing site in Jezero Crater is the focus of the research area because it has ancient river deltas and water cycles that have been identified as similar to Earth's. They are revisiting what humans have done to look for signs of ancient life by researching Martian soil rock samples. Prehistoric humans had previously used crushed stone as a life support tool; this indicates that stone became the foundation for building a human civilization on Earth since the young Stone Age (Neolithic) around the 10th millennium BC. Early humans in Indonesia left some evidence of technology in the form of artifacts of living tools made of simple stone, such as flake tools, splitting axes, planks, and stone axes. From an epistemological perspective, humans are created with the potential in the form of reason to seek the truth and live a better life. Archaeological discoveries in early human life show that tools made of obsidian and volcanic rocks can produce sharp knives for food gathering and hunting. The megalithic tradition does not refer to a particular era of civilization as a form of expression that develops because of the belief in magical or non-physical powers and is supported by the availability of surrounding resources. Megalithic culture, from the perspective of the past, with its diverse characteristics, still survives through time. In contrast, the present and future perspectives require revitalizing local wisdom values stored in the megalithic

cultural heritage to guard the progress of human civilization.

CONCLUSION

Research on Martian rocks is a possible answer to considering Mars as a new human habitation. The megalithic tradition originating from prehistoric times has developed rapidly because it grew together with the development of local culture to form the ability to adapt quickly to changes in human civilization. The context of tradition in terms of the aspect of natural material objects used in traditional rituals becomes a cultural heritage from ancestors or ancestors, which contains the concept of religion as an environmentally sound way of life to protect humans in living their lives. Archaeological remains in the megalithic tradition on tribal life tools in Papua become the potential for social capital between individuals in a group to produce forms of cooperation, such as networks, cooperation, trust, collectives, and solidarity. The manifestation of human ecological intelligence by empowering the local wisdom perspective of the community in megalithic cultural heritage to create a new life outside the earth.

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